CodeWarrior™ Development Tools for StarCore DSP

Targeting Manual

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Table of Contents

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Introduction

This manual describes how to use the CodeWarrior™ Integrated Development Environment (IDE).

This chapter contains the following topics:

- Read the Release Notes
- Related Documentation

Read the Release Notes

Please read the release notes. They contain important information about new features, bug fixes, and incompatibilities that might not have made it into the documentation due to release deadlines. You can find the release notes on the CodeWarrior CD in the `Release Notes` folder.

Related Documentation

This section directs you to useful sections of this manual and other useful documentation.

If you are new to the CodeWarrior IDE:

- See "StarCore Development Tools Overview" on page 15.
- See "CodeWarrior for the StarCore DSP: A Tutorial" on page 19.

For everyone:

- For general information about the CodeWarrior IDE and debugger, refer to the *IDE User Guide*.

To learn more about the StarCore processor and development tools:

- See the *SC100 Assembly Language Tools User's Manual*. (This manual provides information about the assembler and linker and related command-line interfaces.)
- See the *Metrowerks Enterprise C Compiler User's Manual*. (This manual provides information about the compiler and its command-line interface.)
- See the *SC140 DSP Core Reference Manual*. (The preceding manual provides more information about the EOnCE module and the events that you can debug using EOnCE.)
- See the *SC100 Application Binary Interface Reference Manual*.

You can download electronic versions of the manuals in the preceding list from the following World Wide Web page:

```
http://e-www.motorola.com/webapp/sps/library/
docu_lib.jsp
```

For more information on S-records:

- See the *DSP Linker/Librarian Reference Manual*.

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Installing CodeWarrior for the StarCore DSP

This chapter describes how to install the CodeWarrior development tools and contains the following topics:

- System Requirements
- Installing the CodeWarrior Software

System Requirements

The system requirements for Windows®-hosted and Solaris-hosted tools differ:

- Windows Operating System Requirements
- Solaris Operating System Requirements

Windows Operating System Requirements

To install the CodeWarrior IDE and the StarCore Simulator software, you need:

- **Hardware**: Intel® Pentium®-class microprocessor, 64 MB of RAM, and an available parallel port.
- **Operating System**: Windows 98, Windows ME, Windows NT 4.0, Windows 2000, or Windows XP
- **Other**: 350 MB free hard disk space on the disk where you are installing the software.

Solaris Operating System Requirements

To install the CodeWarrior IDE on a Solaris host, you need:

- 250 MB of free disk space

- CD-ROM drive
- Solaris 2.6, Solaris 7, or Solaris 8 operating system (required for local hardware debugging)
- PCI capability (required for local hardware debugging)

Installing the CodeWarrior Software

The installation procedure for the Windows-hosted and Solaris-hosted tools differ:

- Installing the CodeWarrior Software on Windows
- Installing the CodeWarrior Software on the Solaris Operating System

Installing the CodeWarrior Software on Windows

Use the CodeWarrior installer to automatically install all necessary components and files. If you have any questions regarding the installer, read the instructions built into the CodeWarrior installer.

NOTE You must have administrative privileges to install this software on Windows NT, Windows 2000, or Windows XP.

To install CodeWarrior Development Tools for the StarCore DSP, perform the following steps:

1. Run `setup.exe`.

2. Follow the displayed instructions.

3. Restart your computer.

Installing the CodeWarrior Software on the Solaris Operating System

This section describes how to install the CodeWarrior software for the Solaris operating system. To install, you must:

- Install the CodeWarrior development tools for the Solaris operating system

- Install the PCI drivers (for local hardware debugging)

NOTE You must have a valid license file to run the compiler and debugger. The `license.dat` file in the installation directory of your product contains the product license.

To request a permanent or evaluation license, complete the registration form at this World Wide Web address:

`http://www.metrowerks.com`

Evaluation users must enter `Evaluation` in place of the registration number.

You can send an email message about licensing or registration issues to `license@metrowerks.com`.

An electronic registration card resides in the `Registration` subdirectory of the `Release_Notes` directory. The electronic registration card contains additional information about alternate ways to register and license your product if you do not have Internet access.

Install the CodeWarrior Development Tools for the Solaris Operating System

To install the CodeWarrior development tools for the Solaris operating system:

1. Create a temporary directory for installing the tools. For example:

   ```
   mkdir temp_dir
   ```

2. Copy the file `install_sc140.tar` to the temporary directory. For example:

   ```
   cp install_StarCore_Solaris.tar temp_dir
   ```

3. Extract the `install_StarCore_Solaris.tar` file. For example:

   ```
   tar xvf
   install_StarCore_Solaris.tar
   ```

4. Determine the default user shell that is running by typing the following command and pressing Enter:

```
echo $SHELL
```

NOTE You must be running the C shell to complete the installation. Otherwise, consult your system administrator or user's manual for instructions on changing the user shell.

5 If you are running the C shell (`/bin/csh`), start the installation script by running `install_sc140.cshell`.

The script lists the steps to guide you through the installation. The script also presents a menu of options.

6 Select **3, Install StarCore 140 Software Development Tools** and follow the instructions presented.

7 Select **4, Exit**.

8 Restart your start-up file. For example:

```
source $HOME/.cshrc
```

NOTE The `$HOME/.cshrc` file exclusively manages environment variables for CodeWarrior Development Tools for the StarCore DSP. Therefore, you must set those variables manually from the command line unless you first edit the `.cshrc` file to remove the StarCore directory source command.

Install the PCI drivers

To install the PCI (Peripheral Component Interconnect) drivers:

1 Navigate to the `StarCore/motcc_pci` path on the host machine.

2 From a command line prompt in the preceding directory, type the following to install the drivers:

```
./install
```

3 Restart the host machine.

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StarCore Development Tools Overview

This chapter is an overview of the StarCore DSP-specific development tools included with CodeWarrior™ for the StarCore™ DSP

- Metrowerks Enterprise C Compiler
- StarCore 100 Assembler
- StarCore 100 Linker
- StarCore 100 Assembler
- CodeWarrior Debugger
- StarCore Utilities

Metrowerks Enterprise C Compiler

The Metrowerks Enterprise C Compiler:

- Conforms to the American National Standards Institute (ANSI) C standard.
- Conforms to the StarCore Application Binary Interface (ABI) standard.
- Supports a set of digital signal processor (DSP) extensions.
- Supports International Telecommunications Union (ITU)/ European Telecommunications Standards Institute (ETSI) primitives for saturating arithmetic. Additional parameters are available for non-saturating arithmetic and double-precision arithmetic.
- Allows for standard C constructs for representing special addressing modes.
- Supports a wide range of runtime libraries and runtime environments.

- Optimizes for size (smaller code), speed (faster code), or a combination of both, depending on options that you set.

The compiler links all application modules before optimizing. By examining the entire linked application before optimizing, the compiler produces highly optimized code. The compiler performs many optimizations, including the following:

- Software pipelining
- Instruction paralleling and scheduling
- Data and address register allocation
- Loop invariant code motion

StarCore 100 Assembler

The assembler changes assembly language source code to machine language object files or executable programs. (The assembly language source code can be either originally written in assembly language or generated by the compiler.)

The assembler embeds information about errors, warnings, and assembly code in the listing files.

StarCore 100 Linker

The linker combines object files into a single executable file. You specify the link mappings of your program in a linker command file. As an alternative to editing a linker command file in a text editor, you can use the Link Commander utility. The Link Commander lets you manipulate the linker command file using graphical representations of your memory segments and program sections.

CodeWarrior Debugger

The CodeWarrior debugger lets you debugs your software on both simulator and hardware targets. If debugging on a simulator target, you have the additional option of analyzing code performance using the iCacheViewer.

You may debug both unoptimized and optimized code.

StarCore Utilities

The CodeWarrior™ for the StarCore™ DSP software development tools also include some utilities:

- A flash programmer.
- An ELF file dump utility for dumping StarCore DSP ELF object module formatted files in a human-readable form (implemented as a post-linker).
- A utility that converts ELF files to S-record files (implemented as a post-linker).
- A standalone utility called sc100-stat that reads a .eld file and returns certain statistics for the file.
- A utility that converts ELF files to LOD files (implemented as a post-linker).

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CodeWarrior for the StarCore DSP: A Tutorial

This chapter provides step-by-step instructions for developing typical StarCore DSP projects using the CodeWarrior IDE, including the CodeWarrior debugger.

This chapter includes the following topics:

- Using Stationery
- Creating a Project
- Debugging a Project

Using Stationery

Most new projects build upon project stationery. Project stationery is a collection of projects for the various StarCore debug targets.You can use these prebuilt projects as templates for constructing your own new projects.

To use project stationery as a template

1. Select **File > New**

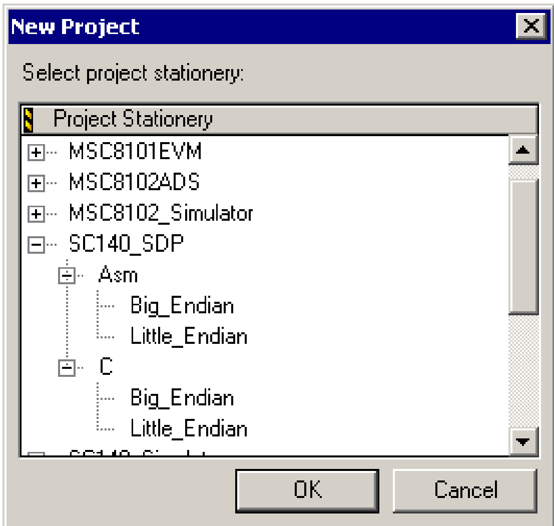
2. Select StarCore Stationery from the list

3. Set a Location and Project Name

4. Click the **OK** button

   The New Project window appears (Figure 4.1)

Figure 4.1 New Project window



There is project stationery for:

- MSC8101ADS
- MSC8101EVM
- MSC8102ADS
- MSC8201 Simulator
- SC140 SDP
- SC140 Simulator
- StarCore Librarian

Some of the project stationery have variants for assembly source projects and endian options.

5 Select a project stationery from the list

6 Click the **OK** button.

The project window for your new project appears in the IDE.

Creating a Project

In this tutorial, we create a new project using the SC140_Simulator project stationery, add our own source code and target settings, and compile the project

- Create a New Project
- Add a New Source File
- View Target Settings
- Build the Project

Create a New Project

Create a new project using the **SC140_Simulator > C > Big Endian** project stationery as described in "Using Stationery" on page 19.

Add a New Source File

1 Choose **File > New**.

The New window appears.

2 Click the File tab.

3 Type the following in the **File name** field:

```
my_main.c
```

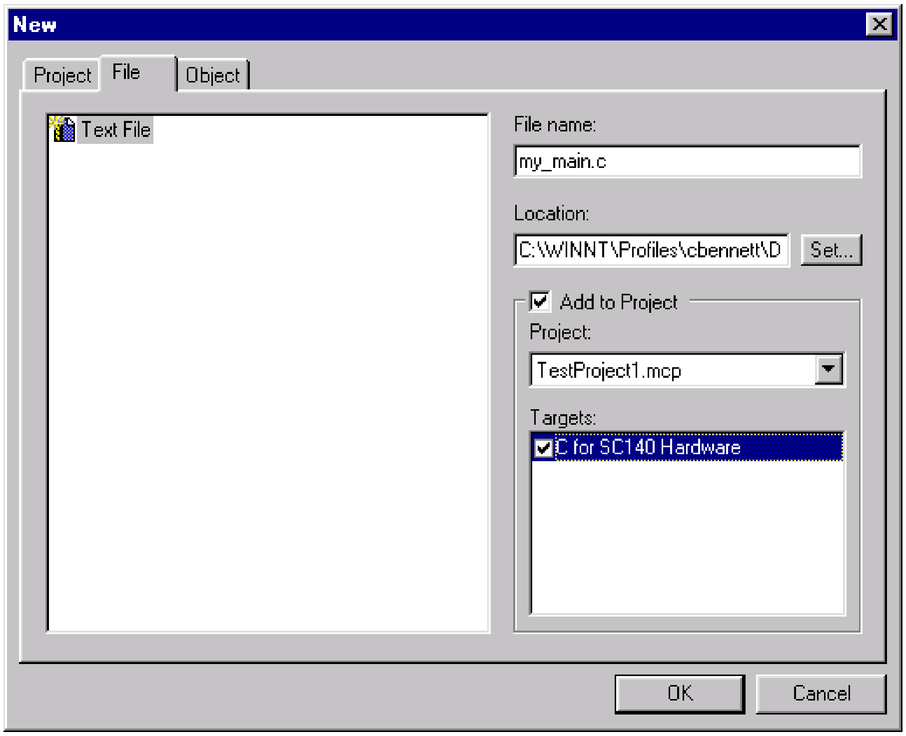
4 Click the Add to Project checkbox to enable it.

5 Ensure that the Project pop-up menu displays the name of your project.

6 In the Targets list box, click the checkbox by the name of the target to which to add the new file.

Figure 4.2 shows the New window as it now appears.

Figure 4.2 New Window When Creating a Text File



7 Click Set to navigate to a different directory and save the file or click OK in the New window to accept the default location.

An editor window appears with the name you specified and the CodeWarrior IDE adds the file to the specified project.

8 Type the following lines of source code in the editor window:

```
#include <stdio.h>

int a = 5;
int b = 10;
int c = 0;

void main(void)
{

  printf("Hello StarCore!\n");

  do {
```

```
  a++;
  b++;
  c = a + b;

  printf("The current value of a is: %d \n", a);
  printf("The current value of b is: %d \n", b);
  printf("The current value of c is: %d \n", c);

  } while (c < 100);

}
```

9. Choose **File > Save** and close the file.

10. Remove the placeholder source file.

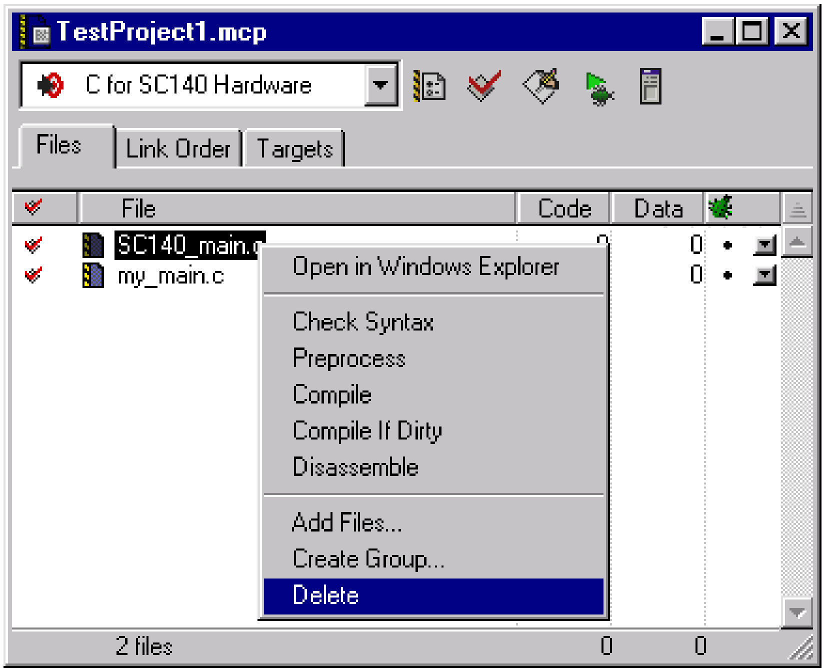
    (The `SC140_main.c` file included with the stationery is a placeholder for your own project files.)

    a. In the Project window, select `SC140_main.c`.

    b. Right-click on `SC140_main.c`.

    c. Select Delete from the pop-up menu, as shown in Figure 4.3.

Figure 4.3 Removing a File from a Project



d. Confirm the file deletion.

Click **OK** in the message box that appears to confirm deleting the file from the project.

View Target Settings

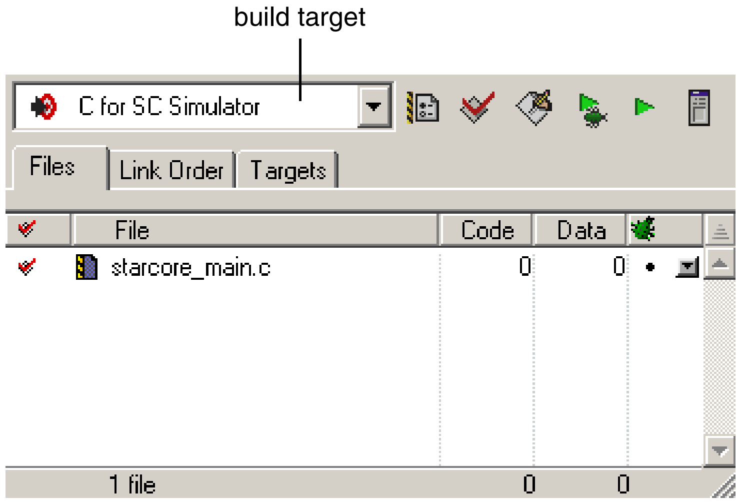
To view target settings:

1 If you need to change the current build target, choose **Project > Set Default Target >** ***Target Name***.

Target Name is the name of the target that you are specifying as the current build target.

The Project window (Figure 4.4) shows the current build target.

Figure 4.4 The Project Window and Current Build Target

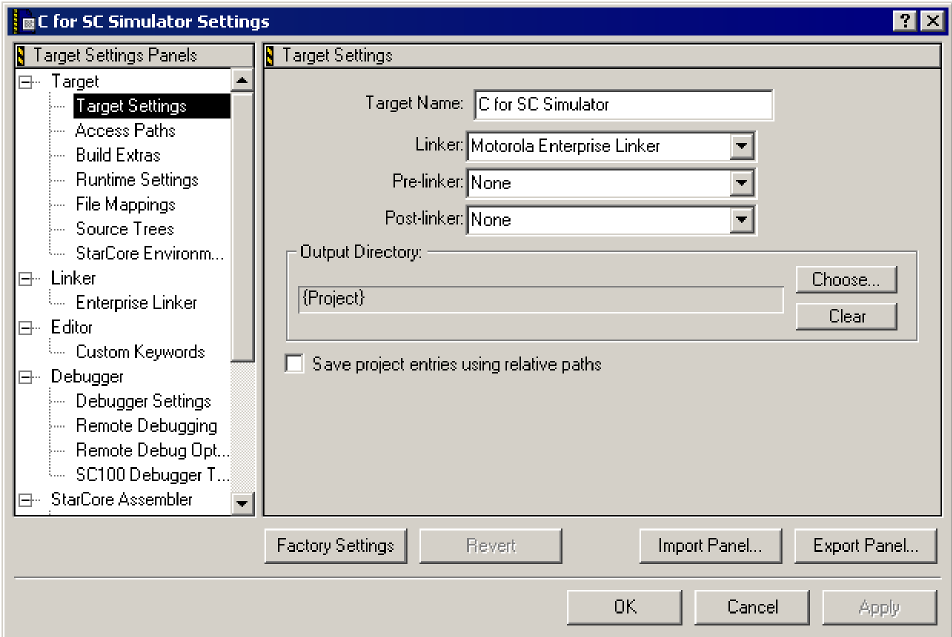


2 Choose **Edit >** ***Target Name*** **Settings**, where ***Target Name*** is the name of the current build target.

NOTE For this example, choose **Edit > C for SC Simulator Settings**.

The Target Settings window appears (Figure 4.5).

Figure 4.5 The Target Settings Window



The Target Settings window groups all possible options into a series of panels. The list of panels appears on the left side of the window. When you select a panel, the options in that panel appear on the right side of the dialog box.

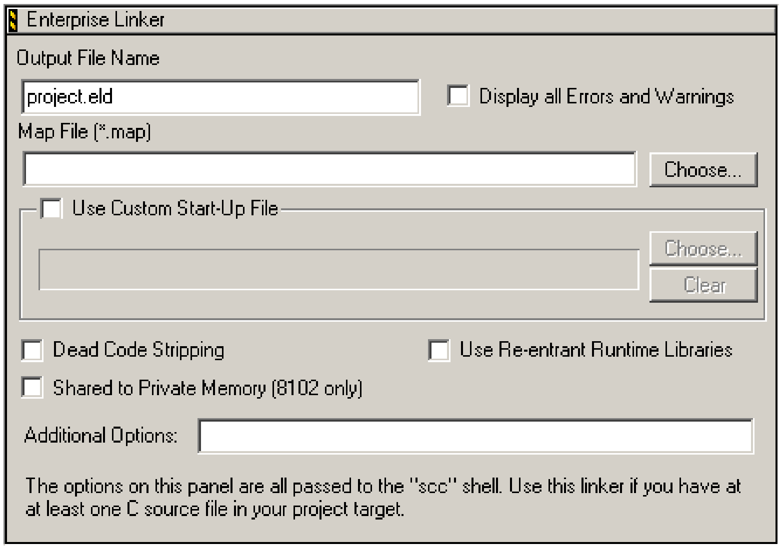
Different panels affect:

- Settings related to all build targets
- Settings that are specific to a particular build target (including settings that affect code generation and linker output)
- Settings related to a particular programming language

3 Select Enterprise Linker from the list of panels in the Target Settings window.

The Target Settings window displays the Enterprise Linker panel, as shown in Figure 4.6.

Figure 4.6 Enterprise Linker Panel



The Output File Name text box contains the name of the output file. This file has the extension `.eld`.

Examine the other settings before closing the Target Settings window.

Build the Project

To build the project:, choose **Project** > **Make.**

After you issue the **Make** command, the CodeWarrior IDE compiles and links all the code in the current build target and generates an executable file.

NOTE The CodeWarrior IDE updates all changed files before compiling so that it compiles the latest version of each file. (The IDE tracks these dependencies automatically.)

Debugging a Project

- Start Debugging
- Set a Breakpoint
- Show Registers

- Finish Debugging

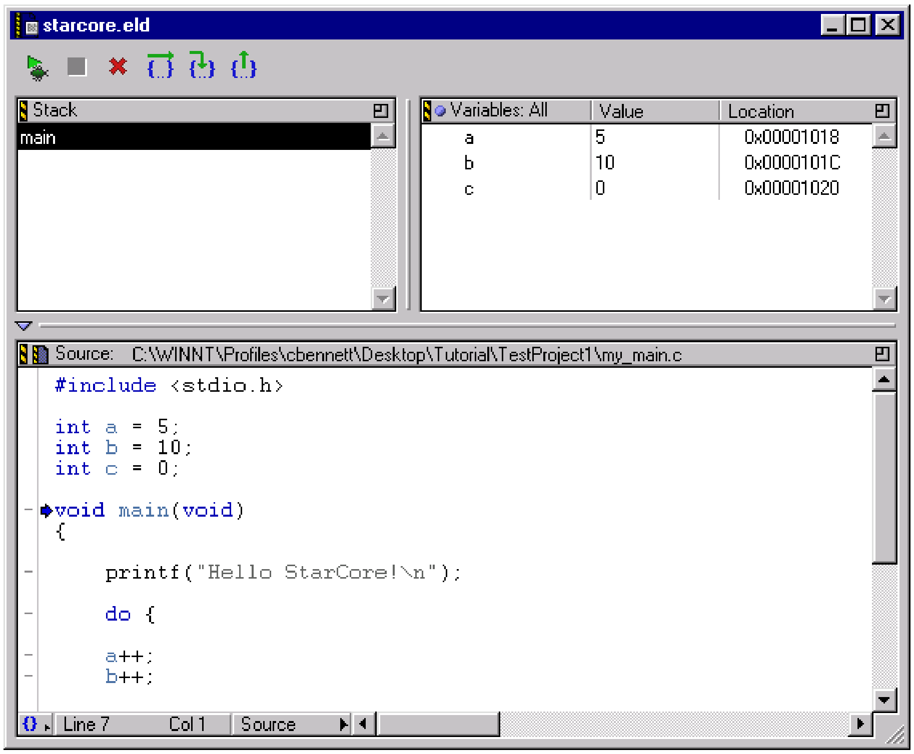
Start Debugging

To run the project, choose **Project > Debug**.

The debugger displays a message box while downloading your application to the target board.

A debugger window (Figure 4.7) appears.

Figure 4.7 Debugger window



Set a Breakpoint

To set a breakpoint:

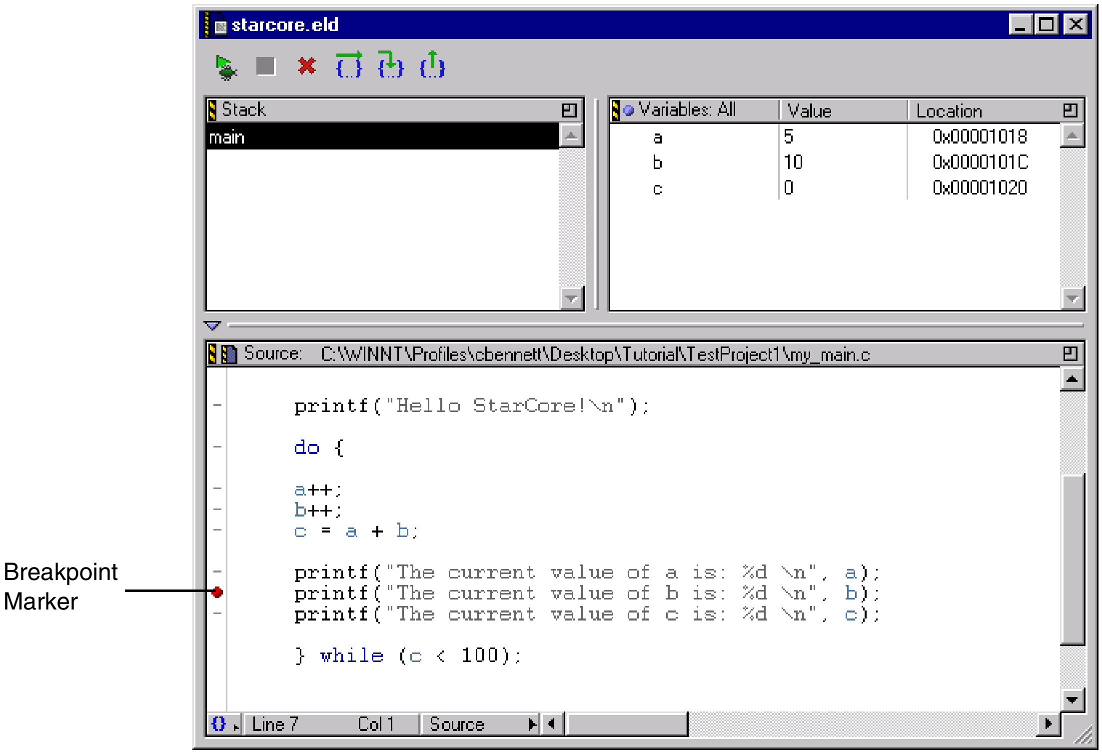
1 In the debugger window, click the gray dash in the Breakpoint column, next to the following line of code:

```
printf("The current value of b is: %d \n", b);
```

A red marker appears (Figure 4.8).

NOTE You also can set a breakpoint by clicking next to a valid line of code in the Breakpoint column of the Editor window.

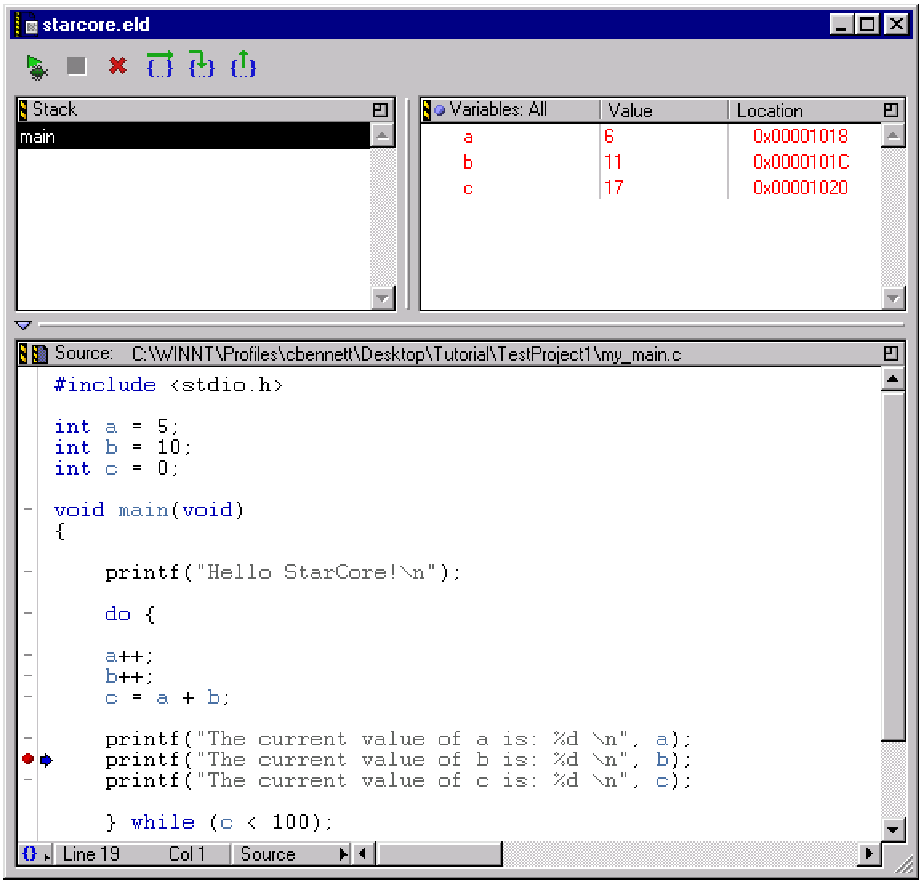
Figure 4.8 Debugger window after Setting a Breakpoint



2 Select **Project > Run** to run to the new breakpoint that you set.

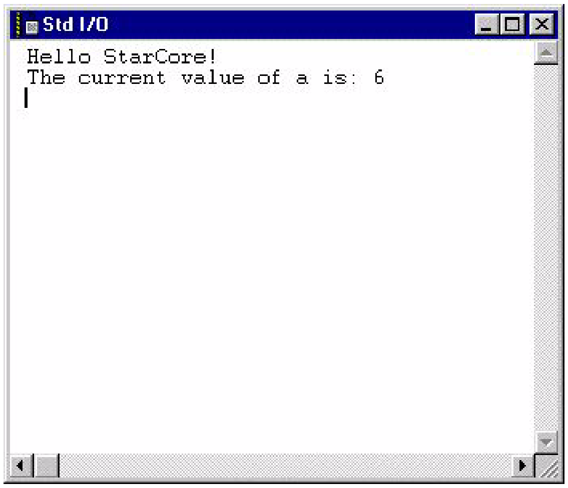
Figure 4.9 shows the debugger window after the program runs to the new breakpoint.

Figure 4.9 Debugger window after Running to Breakpoint



In addition, the IDE displays an output window, as shown in Figure 4.10.

Figure 4.10 Example Program Output Window



You successfully set a breakpoint and ran the debugger to that breakpoint.

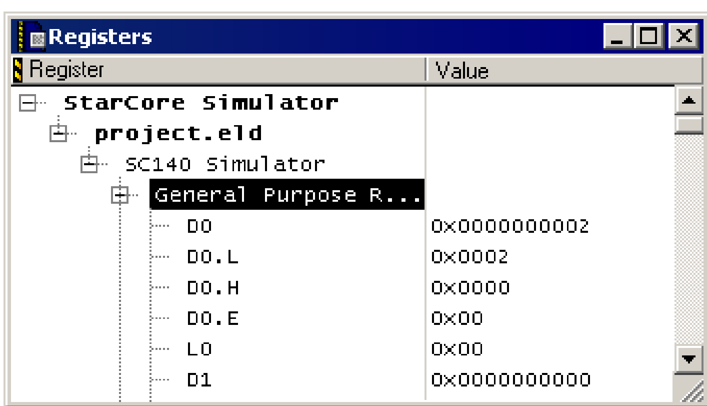
Show Registers

To display registers,

1. Choose **View > Registers**.

   The Registers Window (Figure 4.11) appears, displaying a cascading list of register options, depending on your target processor.

Figure 4.11 Registers Window

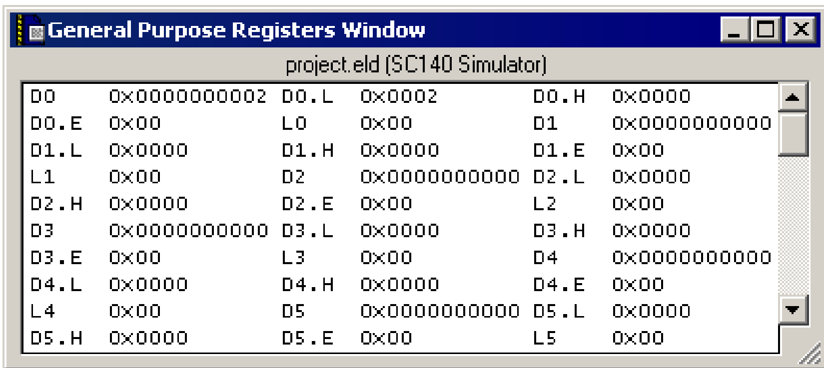


2 Choose a register from the menu.

For this example, double-click **SC140 > General Purpose**.

The CodeWarrior IDE displays an information window for the selected registers.

Figure 4.12 General Purpose Registers Window



Finish Debugging

Choose **Debug > Kill** to finish debugging.

Alternatively, you can choose **Project > Run** to continue debugging in the debugger window.

At this point you have been introduced to the major components of CodeWarrior™ for the StarCore™ DSP. You have seen the project manager, source code editor, and target settings panels.

5

Target Settings

Each build target in a CodeWarrior project has its own settings, some of which are general CodeWarrior project settings and some of which are specific to the platform target.

This chapter and manual describe only the target settings panels that are specific to software development for the StarCore DSP. The settings that you choose affect the compiler, linker, and assembler.

This chapter contains the following topics:

- Target Settings Overview
- StarCore-Specific Target Settings Panels

Target Settings Overview

When you create a project using stationery, the build targets included in the stationery already include default target settings. You can use those default target settings (if the settings are appropriate), or you can change them.

NOTE Use the StarCore project stationery when you create a new project.

Changing Target Settings

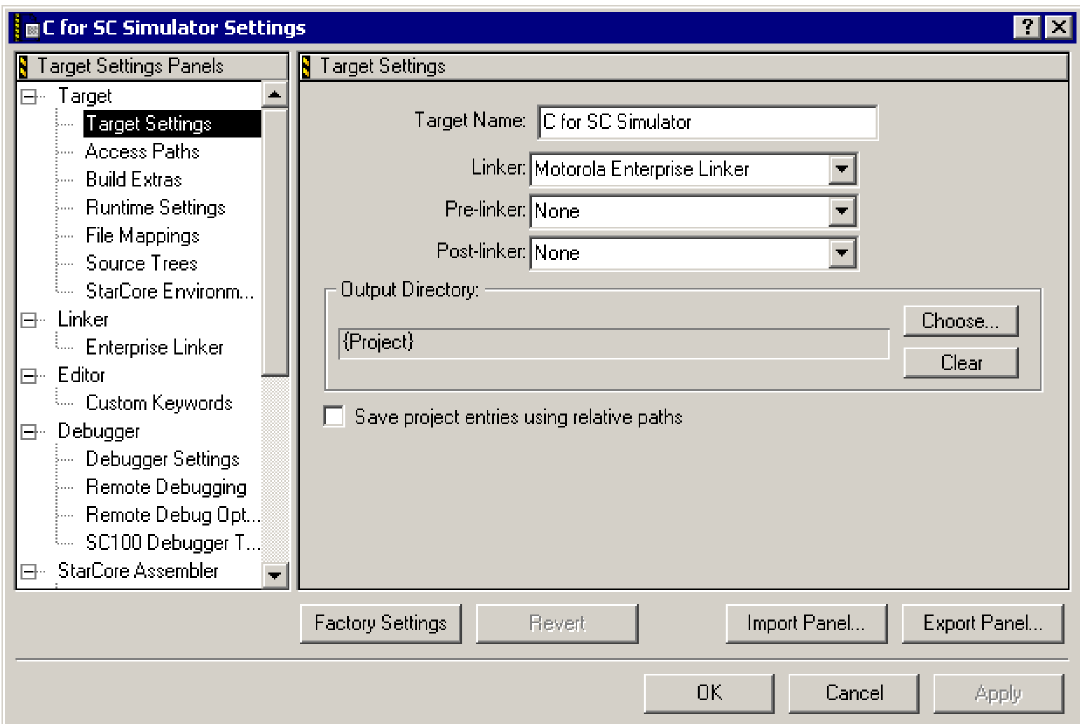
To change target settings:

1 Choose **Edit > *Target Name* Settings.**

Target Name is the name of the current build target in the CodeWarrior project.

After you choose this command, the IDE displays the Target Settings window, as shown in Figure 5.1.

Figure 5.1 Target Settings window



The left side of the Target Settings window contains a list of target settings panels. The list shows only target settings panels that apply to the current build target.

2 In the Target Settings Panels list, click a panel name.

The IDE displays the target settings panel that you selected.

3 Change the settings in the panel.

4 Click OK.

Saving New Target Settings in Stationery

To create stationery files with new target settings:

1 Create a new project.

Create your new project from existing stationery.

2 Change the target settings in your new project for any or all of its build targets.

3 Save the new project in the CodeWarrior stationery folder.

Restoring Target Settings

After you change settings for a target in an existing project, you can restore previous values.

To restore the target settings values, use one of the following methods:

- To restore the previous setting values, click **Revert** at the bottom of the Target Settings window.
- To restore the settings to the factory defaults, click **Factory Settings** at the bottom of the window.

StarCore Linker Target Settings Panels

When you develop StarCore projects, you can choose among the following linkers to create object code from source files:

- Enterprise linker
- DSP linker
- DSP Librarian

NOTE The linker you select determines the target settings panels that appear in the Settings window.

You can create either application files or libraries by selecting a linker. To select a linker:

1. Choose **Edit > *Target Name* Settings.**

2. In the Target Settings Panels list, click Target Settings.

3. To tell the IDE to build libraries, choose DSP Librarian from the Linker pop-up menu. Go to step 5.

NOTE Output files must use the `.elb` file extension when using the DSP Librarian.

Otherwise, go to step 4.

4. To tell the IDE to build an application, choose one of the following items from the Linker pop-up menu:

   - Motorola DSP Linker

     Use the Motorola DSP Linker when creating applications with only assembly source files.

   - Motorola Enterprise Linker

     Use the Motorola Enterprise Linker when creating applications with either C source files or C and assembly source files. This linker expects a C source file that contains a `main()` function.

   Go to step 5.

5. Click OK.

StarCore-Specific Target Settings Panels

Table 5.1 lists and briefly describes the StarCore-specific target settings panels.

Table 5.1 StarCore-Specific Target Settings Panels

Panel	Description
Target Settings	Includes a variety of settings, including those for target operating system, microprocessor, and build target name.
Assembler Preprocessors	Includes assembler-related settings, including settings for where the assembler looks for files and how it handles those files.

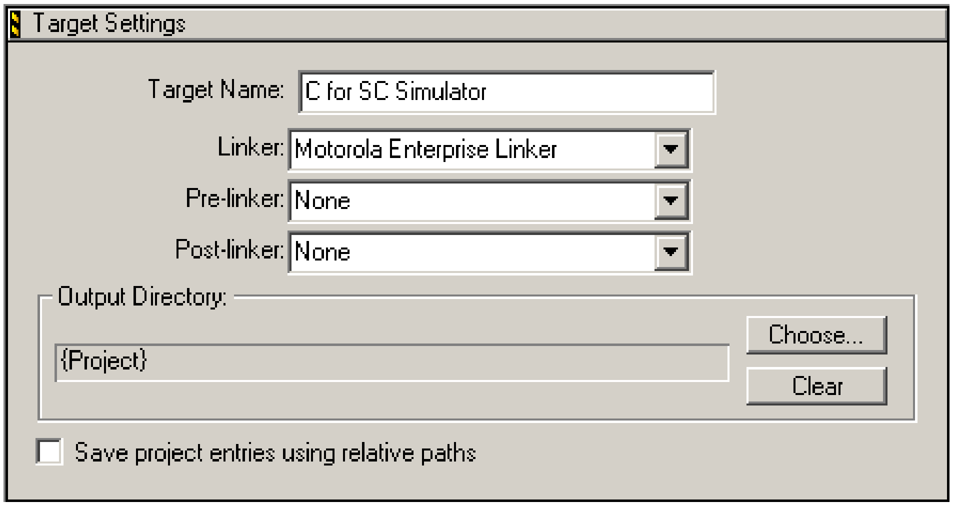
Table 5.1 StarCore-Specific Target Settings Panels

Panel	Description
StarCore Environment	Includes settings for endianness, memory mode, and whether to display generated command lines in a message window.
Enterprise Linker	Contains settings for the Enterprise Linker. The IDE passes the `-Xlink` option to the linker for each option that you select.
DSP Linker	Contains settings that specify link options for building StarCore applications with the Motorola DSP Linker.
DSP Librarian	Contains settings to build libraries for StarCore and to specify the output file name of the library.
C Language	Contains settings related to the version of C that you are using. (If you are using the default version, you do not need to specify any settings on this panel.)
Listing File Options	Contains settings to specify the format and contents of the source listing file. You also can specify other assembler options in the Additional Options text box.
Code & Language Options	Contains settings to specify the symbol options and assembler options for the StarCore Assembler.
Enterprise Compiler	Contains settings to specify the behavior of the compiler, such as where the IDE stops processing files and whether the compiler includes debugging information in the output file.
I/O & Preprocessors	Contains settings to specify additional directories for the IDE to search and to define and undefine preprocessor macros.
Optimizations Target	Contains settings to specify several types of optimization, including space optimization, time optimization, and whether the IDE applies optimizations globally.
Passthrough, Hardware	Contains settings to specify options and arguments to pass to specified tools components.
Remote Debugging	Contains settings that define the communication protocol for the target
SC100 Debugger Target	Contains settings that determine the behavior of the debugger.
SC100 ELF Dump	Contains settings for the ELF file dump utility.
SC100 ELF to LOD	Specifies the output file for the elflod utility.
SC100 ELF to S-Record	Contains the settings for the elfsrec utility.

Target Settings

The target settings panel (Figure 5.2) lets you change the build process of the current build target.

Figure 5.2 Target Settings Panel



The options in this panel are:

- Target Name
- Linker
- Pre-Linker
- Post-Linker
- Output Directory
- Save Project Entries Using Relative Paths

Target Name

Use this text box to set or change the name of a build target. When you use the Targets view in the Project window, you see the name you entered for this option.

The name you specify is the name you assign to the build target for your personal use, not the name of your final output file. You specify the name of the final output file in the **Output file name** text field of the Enterprise Linker, DSP Linker, or DSP Librarian target settings panels. By selecting a link

When you select a linker, you specify the target operating system and chip, if applicable. The other available panels in the Target Settings window change to reflect your choice.

Linker

Choose a linker from the items listed in the **Linker** list box. For StarCore targets, you can choose from the following linkers:

- Enterprise linker
- DSP Linker
- DSP Librarian

In the CodeWarrior IDE, build targets are defined by the chosen linker. Your linker setting determines which other settings panels are visible.

Pre-Linker

Some build targets have pre-linkers that perform additional work (such as data-format conversion) before the IDE builds the final executable file. CodeWarrior™ for the StarCore™ DSP does not require a pre-linker; consequently, choose **None** from the **Pre-Linker** pop-up menu.

Post-Linker

CodeWarrior™ for the StarCore™ DSP has the following choices of post-linker:

- SC100 ELF Dump (uses the ELF file dump utility)
- SC100 ELF to LOD (uses the elflod utility)
- SC100 ELF to S-Record (uses the elfsrec utility)
- Shell Tool Post Linker (supports writing scripts to automate build actions)

After you select a post-linker, you must specify settings in the SC100 ELF Dump target settings panel, the SC100 ELF to LOD target settings panel, or the SC100 ELF to S-Record target settings panel, respectively.

Output Directory

This field shows the directory to which the IDE saves the executable file built from the current project. The default output directory is the

same directory in which the project file resides. To save the executable file to a different directory, click **Choose** to display a standard dialog box. Use the dialog box controls to select a new location and then click **OK**.

Save Project Entries Using Relative Paths

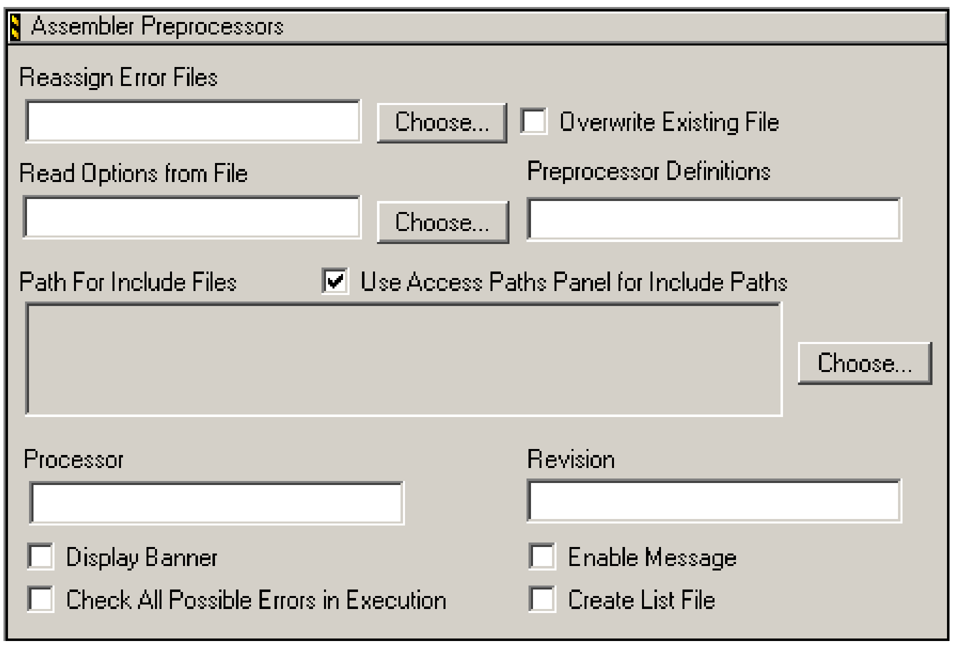
Select this checkbox to cause the CodeWarrior IDE to use relative paths to locate the files in your project. (Relative paths are useful for distinguishing between two or more files with identical names.)

Assembler Preprocessors

Use the Assembler Preprocessors target settings panel to indicate where the assembler looks for files, how it handles those files, and what processor and revision number you are targeting.

Figure 5.3 shows the Assembler Preprocessors target settings panel.

Figure 5.3 Assembler Preprocessors Target Settings Panel



The options in this panel are:

- Reassign Error Files
- Overwrite Existing File
- Read Options from File

- Path For Include Files
- Use Access Paths Panel for Include Paths
- Processor
- Revision
- Display Banner
- Preprocessor Definitions
- Enable Message
- Create List File
- Check All Possible Errors in Execution

Reassign Error Files

You can redirect the standard error file to one other than the default, `errfil` by typing a file name in this field. If you do not select the Overwrite Existing File checkbox, the assembler appends to the file specified in this text box (rather than overwriting the file).

Overwrite Existing File

Select this checkbox to cause the assembler to overwrite the file specified file in the Reassign Error Files checkbox with error information if the file already exists.

Read Options from File

Specify a file that contains command-line assembler optimization options.

Path For Include Files

You can use this text box to specify the standard search path for `include` files. You can specify multiple paths in this option, delimiting each path with a comma. You can specify absolute or relative paths.

The assembler first searches for `include` files in the current directory or the directory specified in the `INCLUDE` directive, if applicable. If the assembler does not find the file, it then prefixes the file name (and optional path name, if applicable) specified in the `INCLUDE` directive with a path name specified in this option. The

assembler then searches each newly created directory path name for the file.

NOTE The assembler issues error messages when header files are in paths separate from source files (and sometimes when the header files are in the same directory as the source file). If you see an error such as the following, you must define the path where the file is located in the Path for Include Files text box:

```
Could not open source file myfile.h
```

Specify multiple paths by using comma delimiters.

Use Access Paths Panel for Include Paths

Select this checkbox to use access paths specified as user paths in the Access Paths target settings panel instead of specifying them in the Path for Include Files text box.

Processor

The **Processor** text field specifies the processor that you are targeting.

Revision

Specify the revision of the processor you are working with in the **Revision** text field. As revisions of silicon are available, changes may be made to the software components that require knowing the silicon revision.

Display Banner

Select this checkbox to cause the assembler to display banner information. (This option has no effect on hosts where the signed banner is not displayed by default.)

Preprocessor Definitions

The **Preprocessor Definitions** text box defines substitution strings that will be used on all the following source lines. This option is equivalent to the `DEFINE` directive. The `string` argument must be

preceded by a blank space and enclosed in single quotes if it contains embedded blanks.

Use a comma-delimited list to specify preprocessor options. For example, "`opt1, opt2`" produces `-D opt1 -D opt2` on the command line.

Enable Message

Select this checkbox to cause the assembler to report assembly progress (for example, the beginning of passes and the opening and closing of input files) to the standard error output stream. This helps you to ensure that assembly is proceeding normally.

Create List File

Select this checkbox to cause the assembler to create a listing file called `lstfil.lst`.

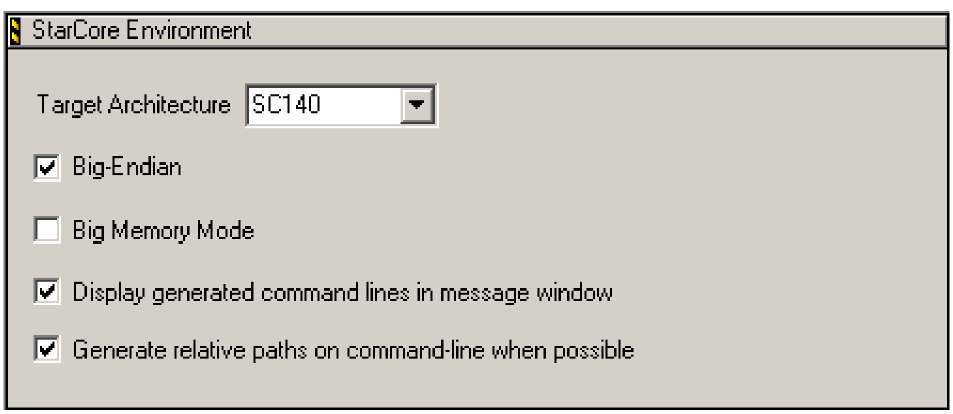
Check All Possible Errors in Execution

Select this option to cause the assembler to check for additional restrictions. Passes `-s all` to the assembler.

StarCore Environment

Use the StarCore Environment target settings panel to specify endianness, memory mode, and whether to display generated command lines in a message window. Figure 5.4 shows the StarCore Environment target settings panel.

Figure 5.4 StarCore Environment Target Settings Panel



Target Architecture

Select the architecture that you are programming for. Your choice determines certain assembler, compiler, and linker settings. You may select from SC110, SC140, SC140e, MSC8101, and MSC8102.

Big-Endian

Select this checkbox to run the application in an environment that uses big-endian byte ordering (meaning that the most significant bits reside in the lower address). Otherwise, the compiler generates little-endian configurations.

If you enable this option, the command-line adapter passes the big-endian option to the compiler, assembler, and linker.

Big Memory Mode

Enable this option to use big memory mode for your application, which is needed if your application does not fit into 64 KB of memory space. In that case, the application must use 32-bit absolute addresses.

The StarCore architecture instruction set supports both 16- and 32-bit addresses. If the application is small enough to allow all static data to fit into the lower 64KB of the address space, the compiler can generate more efficient code. This mode (small memory mode) is the default and requires that all addresses be 16 bits long.

Display generated command lines in message window

Enable this option to display the command line instructions as they are passed to the build tools. The IDE displays the command lines in the Errors and Warnings window.

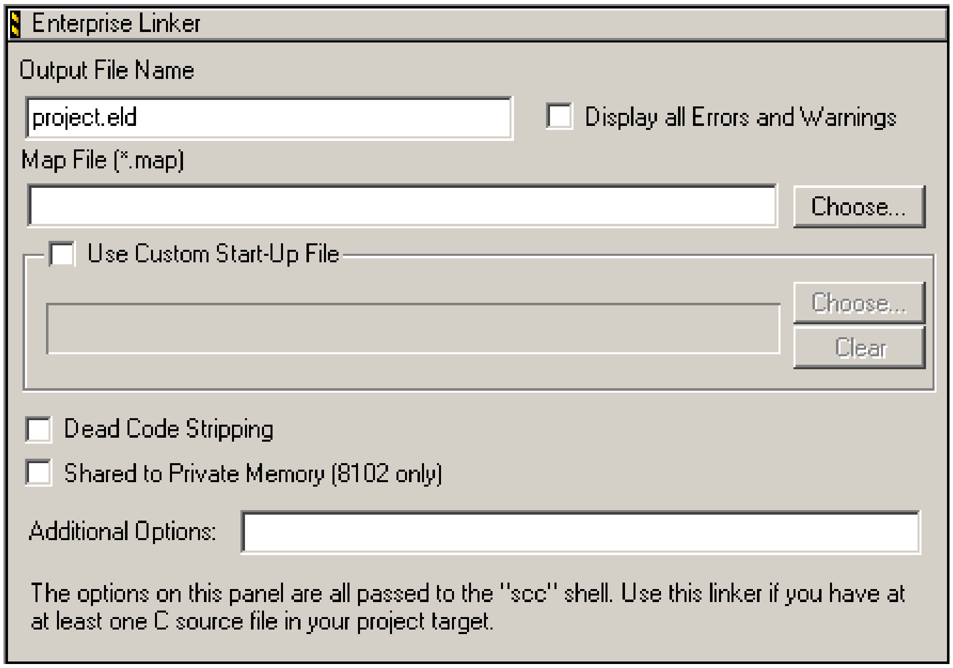
Generate Relative Paths on Command-line When Possible

Enable this option to use relative paths in the compiler, linker and assembler command lines. Paths to source files, object files, and include paths will be relative to the project path. If this checkbox is disabled, the generated command lines contain absolute paths.

Enterprise Linker

The Enterprise Linker target settings panel passes the `-Xlink` option to the linker for each option selected. Figure 5.5 shows the Enterprise Linker target settings panel.

Figure 5.5 Enterprise Linker Target Settings Panel



The options in this panel are:

- Output file name
- Display All Errors and Warnings
- Map File
- Use Custom Start-Up File
- Dead Code Stripping
- Shared to Private Memory (8102 only)
- Additional Options

Output file name

Use this text box to specify the name of the object file to be created. Use a `.eld` extension.

Display All Errors and Warnings

Select this checkbox to display all error messages and warnings.

Map File

Use this text box to create a linker map to a map file. Map files use the `.map` extension.

Use Custom Start-Up File

Enable this option to specify that you wish to link a custom startup file into your application instead of the default file. Enabling this checkbox activates the text box in which you can specify the filename and path of your custom startup file.

Dead Code Stripping

Enable this option to strip unreferenced symbols from your application. This can reduce the memory footprint of your output file.

Shared to Private Memory (8102 only)

Enable this option to allow calls from shared memory to private memory. If this option is disabled, such calls generate error messages.

Additional Options

Use this text box to specify additional options and arguments for the linker.

DSP Linker

Use the DSP Linker target settings panel to specify link options for building StarCore applications with the Motorola DSP Linker.

NOTE This panel appears in the Target Settings Panels list of the Target Settings window only after you choose Motorola DSP Linker from the Linker pop-up menu in the Target Settings panel.

The DSP Linker target settings panel is identical to the Enterprise Linker target settings panel, other than excluding the Additional Options and Start-up File options.

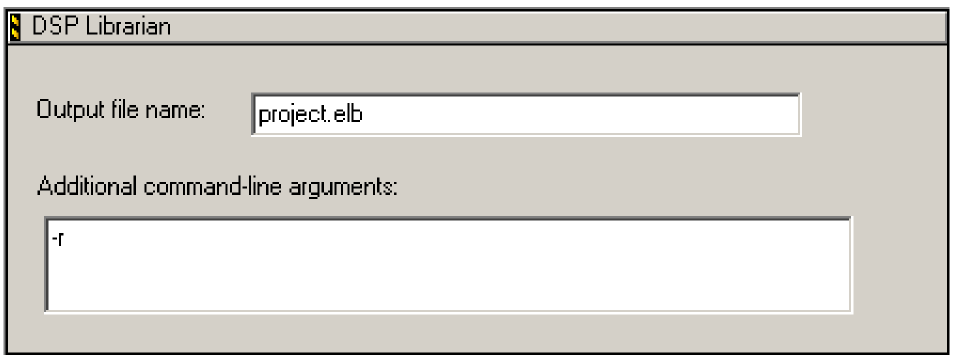
DSP Librarian

Use the DSP Librarian target settings panel to build libraries for StarCore and to specify the output file name of the library.

NOTE This panel appears in the Target Settings Panels list of the Target Settings window only after you select DSP Librarian from the Linker pop-up menu in the Target Settings panel.

Figure 5.6 shows the DSP Librarian target settings panel.

Figure 5.6 DSP Librarian Target Settings Panel



Output file name

Type the output file name in this field. End the file name with the `.elb` extension.

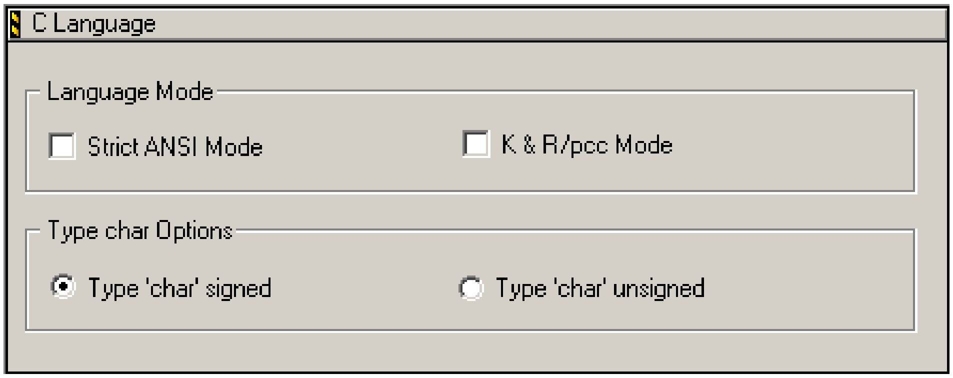
Additional Command Line Arguments

Enter any additional command line arguments to pass to the IDE in this text box.

C Language

Use the C Language target settings panel to specify settings related to the version of C that you are using. Figure 5.7 shows the C Language target settings panel.

Figure 5.7 C Language Target Settings Panel



The default C language mode is the normal ANSI/ISO version with extensions, with all source files using the standard `.c` extension. If you are using the default mode, refrain from enabling any options on the C Language target settings panel.

Otherwise, you must select either the Strict ANSI Mode or the K&R/pcc Mode checkbox.

You can compile source files in only one C language version at a given time. To compile source files in multiple versions, you must compile the code sequentially, changing your choice of version in between compilations.

Strict ANSI Mode

Select this checkbox to cause the IDE to assume that all input source files use the strict ANSI/ISO version of C with no extensions. The compiler flags any extensions found with warnings.

K & R/pcc Mode

Select this checkbox to cause the IDE to assume that you are using this version of C.

Type ‘char’ signed

Select this checkbox to cause the compiler to treat all `char` types as `signed char`.

Type ‘char’ unsigned

Select this checkbox to cause the compiler to treat all `char` types as `unsigned char`.

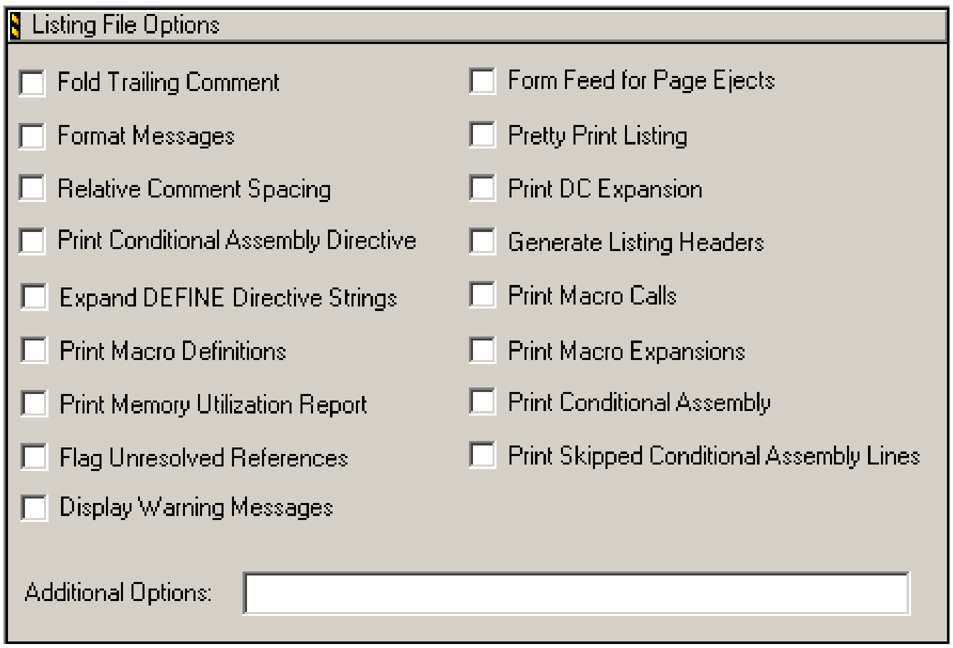
Listing File Options

You can use the Listing File Options target settings panel to specify options for the assembler listing file or other assembler options in the Additional Options text box.

NOTE You can set additional assembler options in the Code & Language Options target settings panel.

Figure 5.8 shows the Listing File Options target settings panel.

Figure 5.8 Listing File Options Target Settings Panel



NOTE You also can use the `OPT` directive in an assembly source file, specifying options in the operand field, separated by commas.

If you specify an assembler option in the Assembler Options target settings panel, the option affects all assembly files in the current target. To specify options only for particular files, use the `OPT` directive in the assembly source file.

Fold Trailing Comment

Select this checkbox to cause the assembler to fold trailing comments in the listing file.

Form Feed for Page Ejects

Select this checkbox to cause the assembler to create form feeds in the listing file.

Format Messages

Select this checkbox to cause the assembler to format messages in the listing file.

Pretty Print Listing

Select this checkbox to cause the assembler to format the listing file for printing purposes.

Relative Comment Spacing

Select this checkbox to cause the assembler to force relative comment spacing in the listing file.

Print DC Expansion

Select this checkbox to cause the assembler to print DC expansions in the listing file.

Print Conditional Assembly Directive

Select this checkbox to cause the assembler to print conditional assembly directives.

Generate Listing Headers

Select this checkbox to cause the assembler to generate listing headers in the listing file.

Expand DEFINE Directive Strings

Select this checkbox to cause the assembler to expand `DEFINE` directive strings in the listing file.

Print Macro Calls

Select this checkbox to cause the assembler to print macro calls.

Print Macro Definitions

Select this checkbox to cause the assembler to print macro definitions.

Print Macro Expansions

Select this checkbox to cause the assembler to print macro expansions.

Print Memory Utilization Report

Select this checkbox to cause the assembler to generate a report with load and runtime memory utilization information.

Print Conditional Assembly

Select this checkbox to cause the assembler to print conditional assembly and section nesting levels information.

Flag Unresolved References

Select this checkbox to cause the assembler to generate a warning at assembly time for each unresolved external reference. This option works only in relocatable mode.

Print Skipped Conditional Assembly Lines

Select this checkbox to cause the assembler to refrain from printing conditional assembly lines.

Display Warning Messages

Select this checkbox to cause the assembler to print all warning messages.

Additional Options

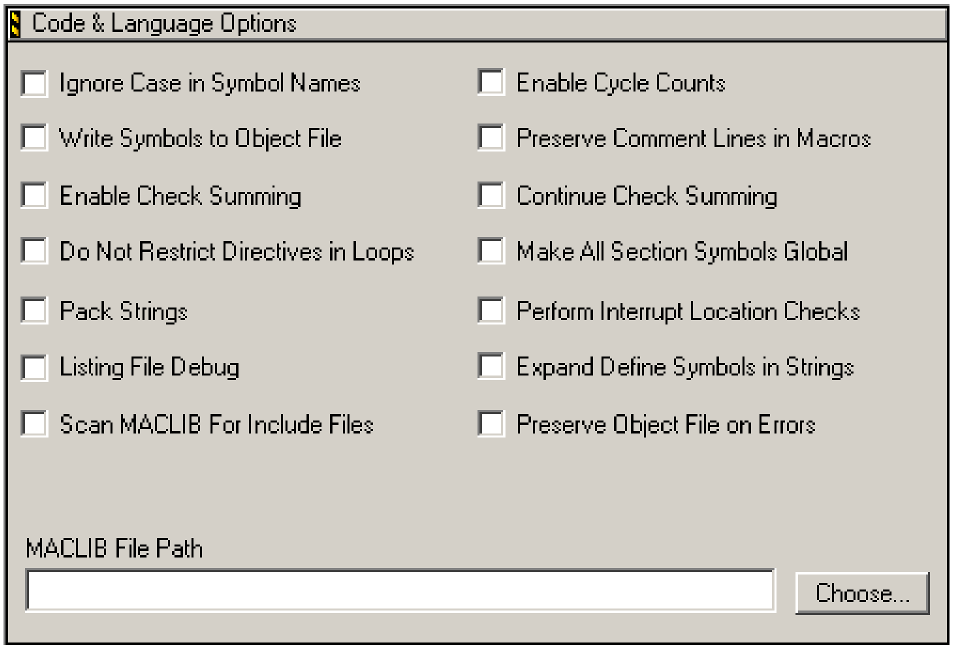
You can type any valid command-line options for the assembler into the Additional Options text box. The IDE passes the options to the assembler.

Code & Language Options

Use the Code & Language Options target settings panel to control the symbol options and assembler options for the StarCore Assembler.

Figure 5.9 shows the Code & Language Options target settings panel.

Figure 5.9 Code & Language Options Target Settings Panel



Ignore Case in Symbol Names

Select this checkbox to cause the assembler to ignore the case of symbol, section and macro names.

Write Symbols to Object File

Select this checkbox to cause the assembler to write symbol information to an object file.

Enable Cycle Counts

Select this checkbox to enable the assembler cycle counter and clear total cycle count features. The output listing for each instruction shows cycle counts. Cycle counts assume a full instruction fetch pipeline and no wait states.

Enable Checksumming

Select this checkbox to cause the assembler to allow checksumming of instruction and data values and to clear the cumulative

checksum. (You also can use the `@CHK()` function to obtain the checksum value.)

Preserve Comment Lines in Macros

Select this checkbox to cause the assembler to preserve comment lines of macros.

NOTE Any comment line in a macro definition that starts with two consecutive semicolons (;;) is never preserved in the macro definition.

Continue Check Summing

Select this checkbox to cause the assembler to re-enable checksumming of instructions and data. This option does not cause the assembler to clear the cumulative checksum value.

Do Not Restrict Directives in Loops

Select this checkbox to cause the assembler to refrain from restricting directives in `DO` loops. You can place directives in `DO` loops, including some `OPT` directives, but this does not always make sense and may be ignored by the assembler. This option suppresses errors on particular directives in loops.

Make All Section Symbols Global

Select this checkbox to cause the same effect as explicitly declaring every section `GLOBAL`. You must select this checkbox before explicitly defining any sections in the source file.

Perform Interrupt Location Checks

Certain DSP instructions may not appear in the interrupt vector locations in program memory. Select this checkbox to cause the assembler to check for these instructions when the program counter is in the interrupt vector bounds.

Expand Define Symbols in Strings

Select this checkbox to cause the assembler to expand `DEFINE` symbols in quoted strings.

Listing File Debug

Select this checkbox to cause the assembler to use the debug source file instead of the assembly language source file. For this option to be valid, you must select the Create List File checkbox to generate a listing file that this option can use.

Scan MACLIB for Include Files

Select this checkbox to cause the assembler to scan the MACLIB directory paths for `include` files in addition to the usual locations. (Usually, the assembler searches for `include` files only in the directory specified as the `INCLUDE` directory or in the paths given by the Path For Include Files option.)

Pack Strings

Select this checkbox to cause the assembler to pack strings in the `DC` directive. The assembler packs individual bytes in strings into consecutive target words for the length of the string.

Preserve Object File on Errors

Normally, the assembler deletes any object file it produces if errors occur during assembly. Select this checkbox to cause the assembler to preserve these object files.

MACLIB File Path

Specify the pathname of a directory that contains macro definitions.

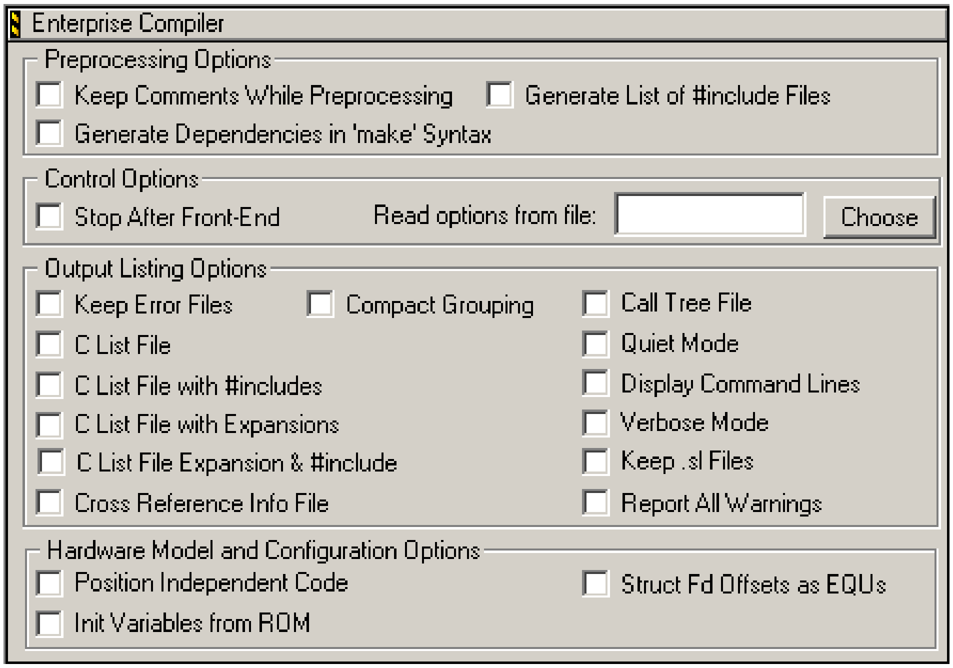
Enterprise Compiler

Use the Enterprise Compiler target settings panel to specify the behavior of the compiler for events such as:

- Where the IDE stops processing files
- The level of warnings returned by the compiler
- Whether the compiler includes debugging information in the output
- Other information that affects the format of object files

Figure 5.10 shows the Enterprise Compiler target settings panel.

Figure 5.10 Enterprise Compiler Target Settings Panel



NOTE The IDE uses the preprocessing options only if you choose **Project > Preprocess** for a C source file in a Project window. During a regular build, the IDE ignores these options.

Keep Comments While Preprocessing

Select this checkbox to cause the compiler to preserve comments in the preprocessor output.

Generate List of #include Files

Select this checkbox to cause the compiler to generate an output file that contains a list of all the `include` files used in the source. This list includes all levels of `include` files, together with any nested files.

Generate Dependencies in ‘make’ Syntax

Select this checkbox to cause the compiler to generate an output file in `MAKE` format containing a list showing the dependencies between the input source files.

Stop After Front-End

Select this checkbox to cause the IDE to stop after processing the input source files through the Front-End. You can use this option to check that the files are valid source files that meet the essential requirements for processing by the IDE (for example, that they contain no syntax errors). This is useful when preparing files for global optimization.

Read options from file

You can create command files containing options and arguments, which the shell treats as if you included them on the command line. Each time you invoke the compiler, you can select a command file with the set of options that suit your requirements.

To specify a shell command file, locate the command file using the Choose button to set the path of this file. Your command file must have a `.opt` file extension.

The IDE does not check whether the options in a command file are valid.

Keep Error Files

Select this checkbox to cause the IDE to create a file containing all error messages generated during the compilation rather than displaying the messages in the Errors and Warnings window. If this option is not enabled, the IDE displays the error messages during processing but does not keep them. The file has the same name as the source file with a `.err` file extension.

Compact Grouping

Enable this option to let the compiler use multiple instruction line pairing to display assembly output.

Call Tree File

Select this checkbox to cause the IDE to generate a postscript file that contains information showing calls in graphical tree form, which can be printed using a postscript printer.

C List File

Select this checkbox to cause the IDE to generate a C list file that lists the entire contents of the source file. The file has the same name as the source file with a `.lis` file extension.

Quiet Mode

Select this checkbox to cause the IDE to display the minimum amount of information (errors only). The IDE omits normal notices and banners.

C List File with #includes

Select this checkbox to cause the compiler to generate a list file that contains the entire contents of the source file and a list of `include` files used by the source. The file has the same name as the source file and the file extension `.lis`.

Display Command Lines

Select this checkbox to cause the IDE to display the specified processing actions without executing them. You can use this option before you invoke a build to check the actions the IDE will take, based on the options selected in the target settings panels. This option does not create object files or link.

C List File with Expansions

Select this checkbox to cause the compiler to create the C list file, which lists the entire contents of the source file, with the addition of expansions (such as macro expansions, line splices and trigraphs). The list file name is the same as the source file with a `.lis` file extension.

Verbose Mode

Select this checkbox to cause the IDE to display all the commands and options being used as it proceeds through different processing stages and invokes the individual tools. The exact information output depends on the processing stages provided by the shell.

C List File Expansion & #include

Select this checkbox to cause the IDE to create a listing file that includes the entire contents of the source file, a list of `include` files,

and expansions (such as macro expansions, line splices and trigraphs). The file has the same name as the source file with the file extension `.lis`.

Keep .sl Files

Select this option to cause the compiler to not delete its assembly language output files (`.sl` files).

Report All Warnings

Enable this option to let the compiler report all possible warnings.

Cross Reference Info File

Select this checkbox to cause the compiler to create a cross-reference information file that provides details of cross-references in the source file. The file name has the same name as the source file with a `.xrf` file extension.

Position Independent Code

Select this checkbox to cause the compiler to generate position-independent code.

Init Variables from ROM

During development you normally use a loader to set the values for global variables and to load these initialized variables into RAM at startup, together with the executable application.

After finishing development, if your final application does not use a loader, you must ensure that when the completed application executes, the initialized variables will be copied from ROM into RAM. To do this, select this checkbox (Init Variables from ROM).

Struct Fd Offsets as EQUs

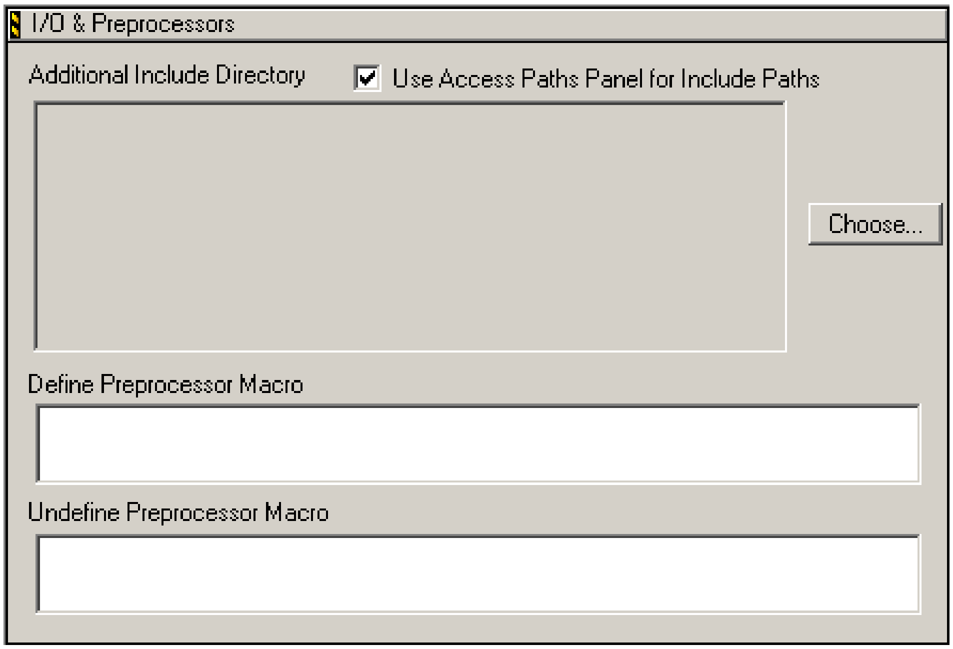
Select this checkbox to cause the compiler to create a file that includes the details of C data structures in the output assembly file. The output assembly file shows the offsets for all field definitions in each data structure.

I/O & Preprocessors

Use the I/O & Preprocessors target settings panel to specify additional directories for the IDE to search and to define and undefine preprocessor macros.

Figure 5.11 shows the I/O Preprocessors target settings panel.

Figure 5.11 I/O & Preprocessors target settings panel



Additional Include Directory

Use this text box to add directories to the `include` file search path. You can specify absolute or relative paths. Specify each path with a comma delimiter.

Use Access Paths Panel for Include Paths

Select this checkbox to use access paths specified as user paths in the Access Paths target settings panel instead of specifying them in the Path for Include Files text box.

NOTE On Windows hosts, the command-line limit is 32 kilobytes. If you receive errors abut having too many include paths, you must remove recursive paths from the Access Paths panel.

Define Preprocessor Macro

Use this text box to define a preprocessor macro with a specified value. If you omit the value, the IDE assumes the value is 1. After you define a preprocessor macro with this option, the shell passes it to the preprocessor for all subsequent compilations until you undefine it using the Undefine Preprocessor Macro option.

Specify multiple preprocessor macros using comma delimiters.

Undefine Preprocessor Macro

Use this text box to undefine a previously defined macro definition. (After you undefine a macro, you must redefine it before using it again.)

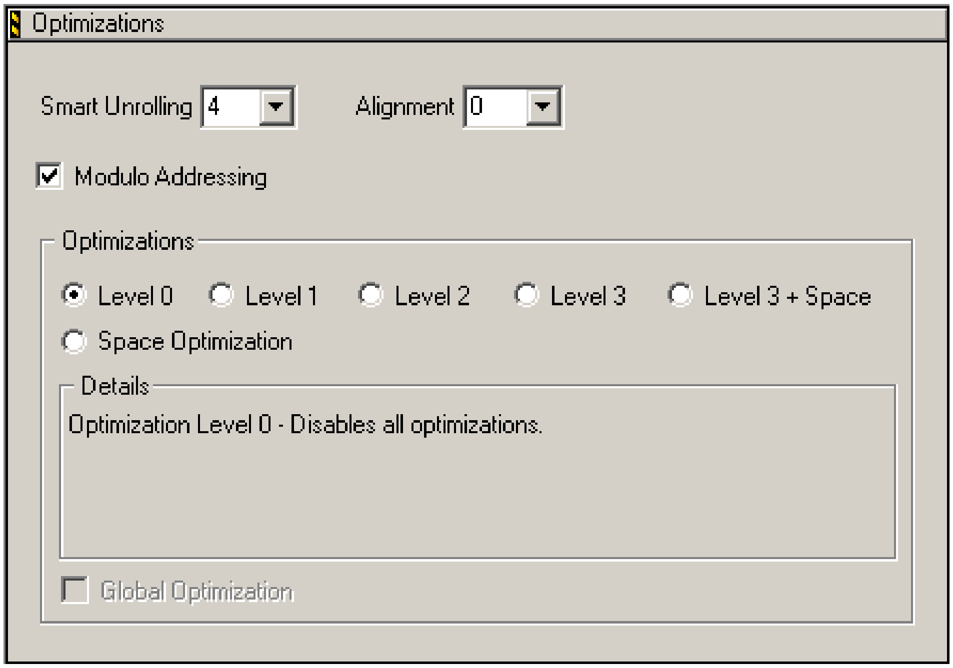
Specify multiple preprocessor macros using comma delimiters.

NOTE The IDE processes any Undefine Preprocessor Macro options only after processing all Define Preprocessor Macro options.

Optimizations Target

You can use the Optimizations target settings panel to specify several types of optimization. Figure 5.12 shows the Optimizations target settings panel.

Figure 5.12 Optimizations Target Settings Panel



The optimizer can apply any of the optimizations in either global or non-global optimization mode. You usually apply global optimization at the end of the development cycle, after compiling and optimizing all source files individually or in groups.

Smart Unrolling

This listbox lets you select the unrolling factor that determines whether a loop should be unrolled.

Alignment

This list box lets you select the alignment level of the compiler. Select from five levels:

- 0. Disable alignment
- 1. Align hardware loops
- 2. Align hardware and software loops

- 3. Align all existing labels
- 4. Align all existing labels and subroutine return points

Modulo Addressing

Enable this checkbox to let the compiler to use modulo addressing.

NOTE Typically, the number of MAC Units specified is four. However, if you are compiling for a specific hardware configuration that comprises less than four MAC units, you must specify the correct number of units.

Optimizations

Specify one of several different levels of optimizations, as follows:

- Level 0 disables all optimizations and corresponds to the `-O0` command-line compiler option.
- Level 1 enables the same optimizations as the `-O1` command-line compiler option.
- Level 2 enables the same optimizations as the `-O2` command-line compiler option.
- Level 3 performs the same optimizations as the `-O3` command-line compiler option.
- Level 3 + Space performs the same optimizations as both the Level 3 (`-O3`) and Space (`-Os`) optimizations.
- Space Optimization optimizes your code for size. In certain cases, this may be at the expense of program speed, resulting in a program that is small in size but executes more slowly than a program without this optimization.

For a general description of the optimization levels, see the Details area of the Optimizations target settings panel.

NOTE You can select the Global Optimization checkbox with any of the preceding optimization levels except Level 0.

Global Optimization

Select this checkbox to apply optimizations across all the files in the application (the most effective method of optimization). (The

command line adaptor passes the `-cfe` option to the compiler and --`Og` to the shell during the link phase after you select this checkbox.)

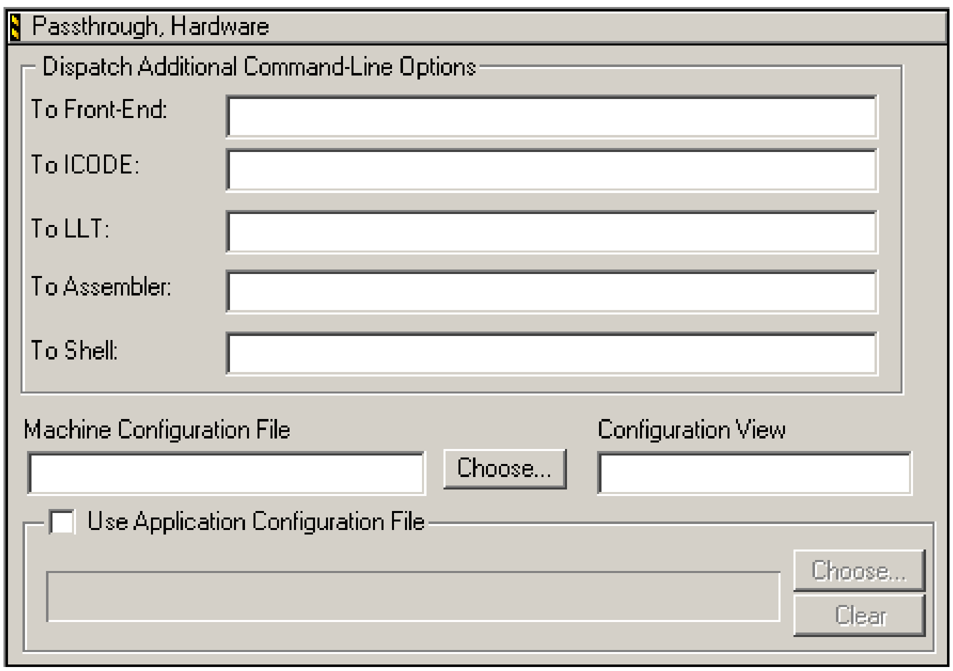
If this option is enabled, the compiler creates object files with the `.obj` file extension.

NOTE When you apply global optimization, the IDE applies a value of -1 for code size and data size to a file that is globally optimized rather than reporting the code and data size in the Project window.

Passthrough, Hardware

Use the **Passthrough, Hardware** target settings panel to specify options and arguments to pass to specified tools components. Figure 5.13 shows the **Passthrough, Hardware** target settings panel.

Figure 5.13 Passthrough, Hardware Target Settings Panel



To Front-End

This option passes `-Xcfe` and the options that you specify in the text field to the shell.

To ICODE

This option passes `-Xicode` and the options that you specify in the text box to the shell.

To LLT

This option passes `-Xllt` and the options that you specify in the text field to the shell.

To Assembler

Use this text box to specify options and arguments for the assembler. (This option passes `-Xasm` and the options you specify.)

To Shell

Use this text box to specify any commands to pass to the compiler shell (scc) during compile time. The IDE passes the options exactly as you type them and does not check for errors.

Machine Configuration File

Use this text box to specify a different machine configuration file than the default machine configuration file. The compiler then reads and uses the alternate file that you specify.

Configuration View

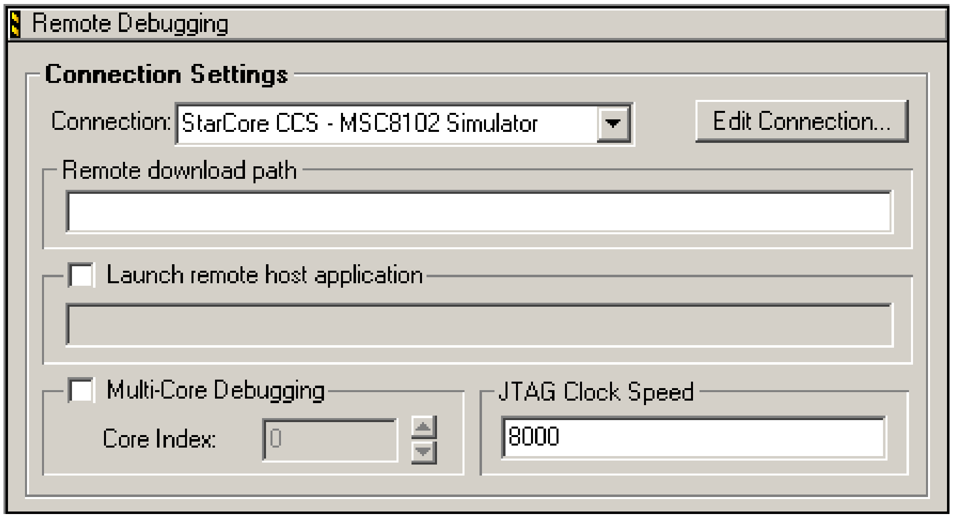
Use Application Configuration File

Enable this option to specify an alternate application file for the compiler to read. instead of the default application file.

Remote Debugging

The **Remote Debugging** panel (Figure 5.13)lets you specify the connection that the IDE uses to communicate with the target. The connections themselves are defined in the Remote Connections IDE preference panel-the options here allow you to select one of them.

Figure 5.14 Remote Debugging panel



Connection

This list box lets you select the connection for this target from the list of available remote connections.

Edit Connection

This button lets you edit the definition of the currently selected remote connection. It is provided as a shortcut, and performs the same function as selecting **Edit > Preferences > Debugger > Remote Connections > Change** from the main menu bar.

Changing the definition of a remote connection changes the definition universally. If you wish to edit the connection for this target only, you should create a new connection for this target in the **Remote Connections** IDE Preferences panel.

Remote Download Path

This text box lets you specify the path you wish to use for downloading files.

Launch Remote Host Application

Enable this option to launch an application on the remote computer to server as ahost application.

Multi-Core Debugging

Enable this option if you are debugging multiple cores.

Core Index

This text box lets you specify the core index ID of the target core. This option is only available if the Multi-Core Debugging option is enabled.

JTAG Clock Speed

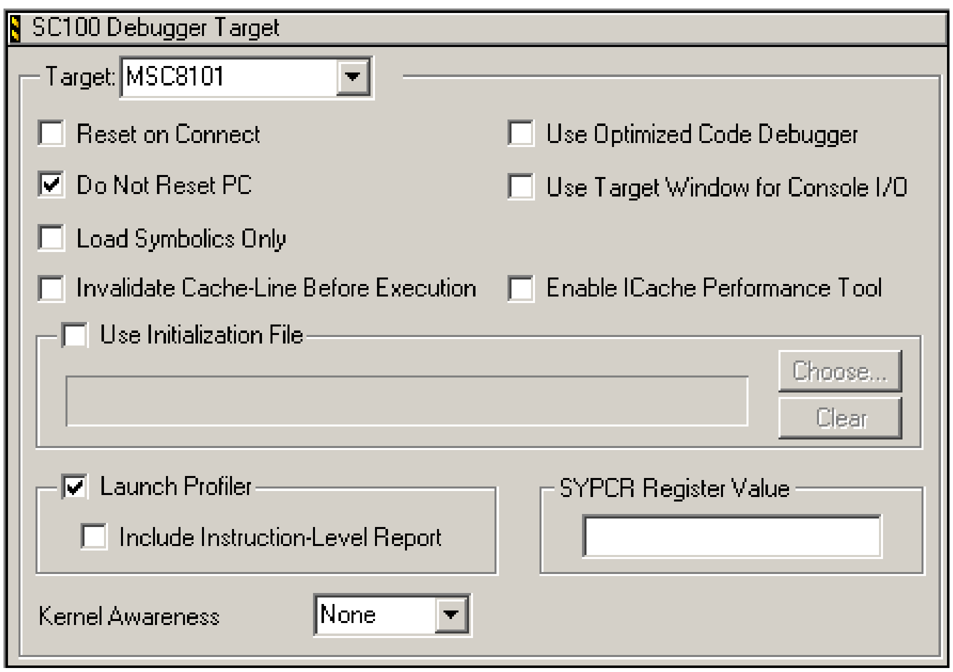
This text box lets you specify the clock speed in MHz of your JTAG connection.

SC100 Debugger Target

Use the SC100 Debugger Target panel to set communications protocols for SC100 targets.

Figure 5.15 shows the SC100 Debugger Target panel.

Figure 5.15 SC100 Debugger Target Panel



You can use the CodeWarrior debugger to launch StarCore applications in the CodeWarrior IDE. You can choose to run the

CodeWarrior debugger either with a simulator or by downloading application code to a hardware board and then debugging the code while it runs on the board.

Target

Choose either a simulator or the name of the target hardware.

Reset on Connect

Select this checkbox to cause the CodeWarrior IDE to issue a reset to the target board each time you download the program for debugging.

Do Not Reset PC

Enable this option to preserve the program counter if you restart a debug session.

Load Symbolics Only

Select this checkbox to cause the IDE not to download code to the target board. (The IDE assumes the code is already there.)

This option is useful if you are debugging a program in ROM. In addition, this option is useful so that you do not have to repeatedly download the same program in multiple, consecutive debugging sessions.

Invalidate Cache-Line Before Execution

Enable this option if you intend to debug code on the MSC8102 or any other target with an instruction cache. This option only appears if the target is set to MSC8102.

Use Optimized Code Debugger

Enable this option to debug optimized code. See Optimized Code Debugging for more information.

Use Target Window for Console I/O

Enable this option to open a console window specifically for this target. If this option is not enabled, the IDE handles all console functions within a general console window.

Enable ICache Performance Tool

Enable this option if you wish to use the ICache Performance Tool to analyze an MSC8102 or MSC8102 simulator target. This option only appears if the target is set to MSC8102 or MSC8102 simulator, and is mutually exclusive to the Launch Profiler option.

Use Initialization File

Specify the name of the initialization file. The initialization file is a text file that tells the debugger how to initialize the hardware after reset but before downloading code. Use the initialization file commands to write values to various registers, core registers, and memory locations.

Launch Profiler

Select this checkbox to launch the profiler when you start debugging. If you are debugging multiple targets, select this checkbox for each target to profile.

This option and the Enable ICache Performance Tool option are mutually exclusive.

SYPCR Register Value

Use the SYPCR Register Value text box to set a value for the MSC8101 SYPCR register. This option is only available if you set the target to MSC8101. A value of 0xFBC3000 disables the watchdog timer.

Include Instruction-Level Report

Select this checkbox to cause the profiler to produce an instruction-level report that contains counting and parallelism information.

NOTE Selecting this checkbox increases profiler execution time.

Kernel Awareness

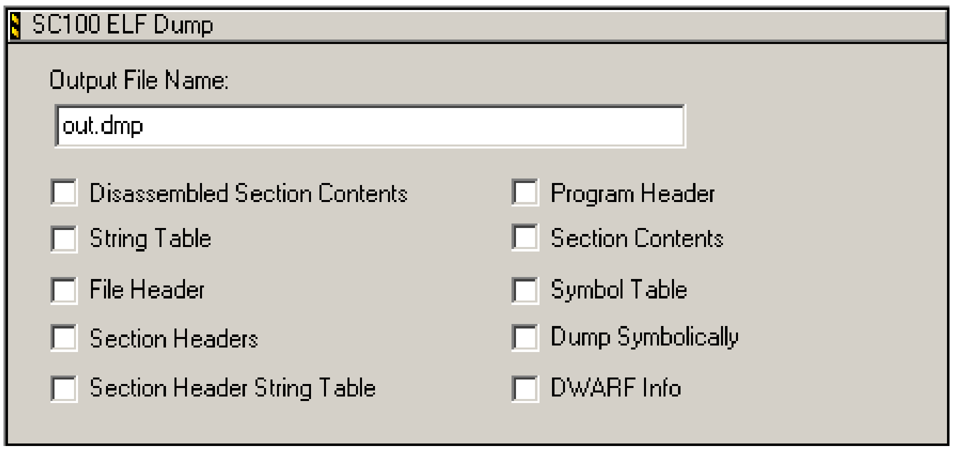
Select the RTOS (real-time operating system) that you are using, or select None if you are not using an RTOS.

SC100 ELF Dump

Use the SC100 ELF Dump target settings panel to set parameters for the ELF file dump utility.

Figure 5.16 shows the SC100 ELF Dump target settings panel.

Figure 5.16 SC100 ELF Dump Target Settings Panel



Output File Name

Specify the name of the ELF dump file in this text field.

Disassembled Section Contents

This option dumps the disassembled section contents to the specified output file.

String Table

This option dumps the string table to the specified output file.

File Header

This option dumps the file header to the specified output file.

Section Headers

This option dumps the section headers to the specified output file.

Section Header String Table

This option dumps the section header string table to the specified output file.

Program Header

This option dumps the program header to the specified output file.

Section Contents

This option dumps the section contents to the specified output file.

Symbol Table

This option dumps the symbol table to the specified output file.

Dump Symbolically

This option dumps the ELF file symbolically.

DWARF Info

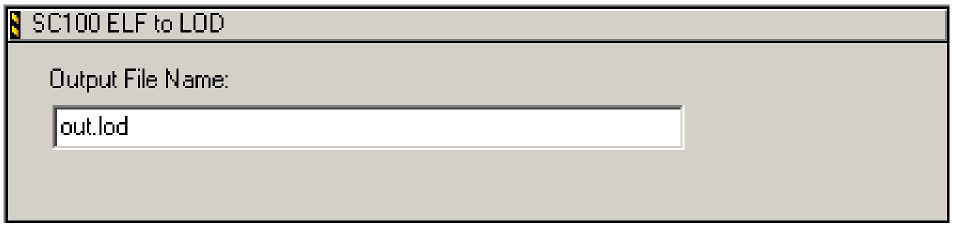
This option dumps the DWARF debugging information to the specified output file.

SC100 ELF to LOD

Use the SC100 ELF to LOD target settings panel to specify the output file for the elflod utility.

Figure 5.17 shows the SC100 ELF to LOD target settings panel.

Figure 5.17 SC100 ELF to LOD Target Settings Panel



Output File Name

Specify the name of the file to which you want the ELF to LOD post-linker to write the LOD records.

The ELF to LOD post-linker (also known as elflod) writes the information from the ELF file into a specially formatted ASCII file called a LOD file. Listing 5.1 shows the format of the LOD file.

Listing 5.1 Format of the LOD file

```
_START Module_ID Version Rev# Device# Asm_Version Comment
_END Entry_point_address
_DATA Memory_space Address Code_or_Data
_BLOCKDATA Memory_space Address Count Value
_SYMBOL Memory_space Symbol_Address ...
_COMMENT Comment
```

SC100 ELF to S-Record

Use the SC100 ELF to S-Record target settings panel to specify the parameters for the elfsrec utility.

Figure 5.18 shows the SC100 ELF to S-Record target settings panel.

Figure 5.18 SC100 ELF to S-Record Target Settings Panel

Output File Name

The name of the file to which the elfsrec post-linker writes the S-records.

Addressability

You can choose byte-, word-, or long-word-addressability for the S-record file.

Use Memory Offset

Select the Use Memory Offset checkbox to specify that the elfsrec post-linker adds a memory offset value to the memory address of each line in the S-record file.

Offset Amount

Specify a memory offset in hexadecimal or decimal format. (You must precede hexadecimal numbers with `0x`.)

6

Debugging

This chapter describes the StarCore-specific features that are available to you while debugging your code. The standard features of the CodeWarrior debugger are described in the *IDE User Guide*.

This chapter contains the following topics:

- Stack Crawl Depth
- Register Windows
- Register Details Window
- Tips for Debugging Assembly Code
- Cycle Counter in the Simulator
- Loading a .eld File without a Project
- System-Level Connect
- Initialization File
- Kernel Awareness
- Command-Line Debugging
- Load Save Fill Memory
- Load Save Registers

Stack Crawl Depth

The maximum depth of the stack crawl is 26 stack frames.

Register Windows

Choose **View > Register Windows** to view the selections for available StarCore registers.

The registers are presented in a tree format. To edit a value, double-click on a register value and enter the value you want (in hexadecimal notation).

Register Details Window

You can use the Register Details window to view StarCore registers and see descriptions of them.

XML files contain the register descriptions.

The XML register description files reside in the following path:

Windows *CodeWarrior_dir*`\bin\Plugins\support\Registers`

Solaris *install_dir/CodeWarrior_ver_dir*`/CodeWarrior_IDE/CodeWarrior_Plugins/support/Registers`

By default, the CodeWarrior IDE searches all folders in the preceding directory when searching for a register description file. Register description files must end with the extension `.xml`.

The minimum resolution of bitfield descriptions is limited to two bits. Consequently, the Register Details window cannot display single-bit overflow registers.

The maximum resolution of bitfield descriptions is 32 bits. Because the data registers (D0-D15) are 40 bits wide, you cannot view all the bits in a data register simultaneously. Instead, you must view groups of bits—high, low, and extended. For example, to view the bits of the D0 register, use the following XML register description files:

- D0.E
- D0.L
- D0.H

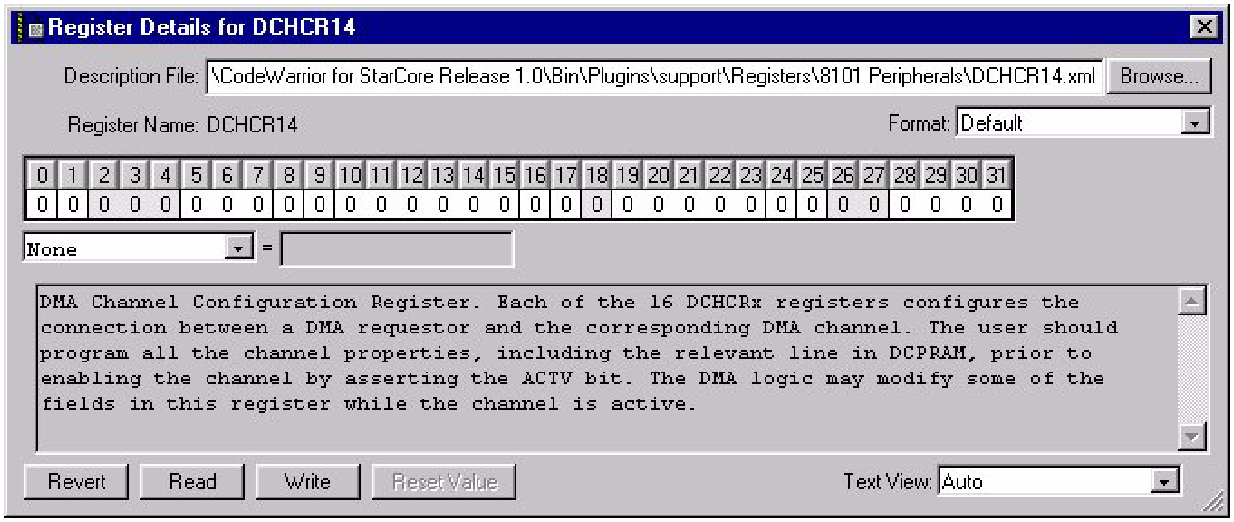
View Register Descriptions

To see registers and register descriptions:

1 Choose **View > Register Details** (Windows operating system) or **View > Register Details Window** (Solaris operating system) to view the Register Details window.

The IDE displays the Register Details window as shown in Figure 6.1.

Figure 6.1 Register Details Window



2 In the Description File text box, type the name of the register to view. (Alternatively, you can use the Browse button to locate the register description files.)

NOTE Some registers have multiple modes (meaning that the bits of the register can have multiple meanings depending on the mode the register is in). If the register you are examining has multiple modes, browse the register description files to find the correct file for the register and mode that you are examining.

For example, the OR*x* registers have multiple modes. The register description files for these registers have an underscore followed by a group of letters that indicate the mode, as follows:

```
ORx_GCPM
ORx_UPM
ORx_SDRAM
```

(The *x* is a number between 0 and 11, excluding 8 and 9.)

Similarly, other multi-mode registers have description files that use an underscore followed by an appropriate suffix.

The Register Details window displays the applicable register values and descriptions.

NOTE You can change the format in which the CodeWarrior IDE displays the registers by using the Format pop-up menu. You also can change the text information that the CodeWarrior IDE displays by using the Text View pop-up menu.

Tips for Debugging Assembly Code

When you set a breakpoint in assembly source code, the source pane of the Thread window does not show the source code preceding the last breakpoint reached. You must change the value of the program counter (which changes the location that the IDE displays in the program) to view that source code.

NOTE Ensure that the address value that you enter is less than that of the current location when you change the program counter value.

(Alternatively, you can view assembly sources in the memory window.)

Change the Program Counter Value

To change the program counter value:

1. Choose **Debug > Change Program Counter**.

   The Change Program Counter dialog box appears.

2. Enter an address (in hexadecimal notation).

   The Source pane in the Thread window updates with the program counter at the specified location.

Cycle Counter in the Simulator

The SC100 menu contains items that enable you to get the cumulative machine cycle count and the machine instruction count when using the simulator for debugging.

Table 6.1 lists and describes the commands in the SC100 menu.

Table 6.1 SC100 Menu Commands

Menu Command	Description
Get Simulator Statistics	Displays the current machine cycle count and machine instruction count in an alert box.
Reset Machine Cycle Count	Resets the machine cycle count to zero.
Reset Machine Instruction Count	Resets the current machine instruction count to zero.

Due to the nature of the simulator, cycle counting is accurate only when executing continuously (rather than single-stepping through instructions). The cycle counter is more useful for profiling than interactive use.

The following process describes how to determine the number of machine cycles the simulator uses to execute a chosen algorithm:

1. Set a breakpoint before the beginning of a particular algorithm.
2. Set a breakpoint after the end of the same algorithm.
3. Execute the program to the first breakpoint.
4. Reset the machine cycle count.
5. Execute the program to the second breakpoint.
6. Get the machine cycle count.

Loading a .eld File without a Project

You can load and debug a `.eld` file without an associated project.

To load a `.eld` file for debugging without an associated project:

1. Launch the CodeWarrior IDE.

2. Choose **File > Open** and specify the file to load in the standard dialog box that appears.

   Alternatively, you can drag and drop a `.eld` file onto the IDE.

3. Choose the appropriate debugging target from the Target pop-up menu in the SC100 Debugger Target panel.

NOTE If your source code files reside in a different directory than the `.eld` file, specify the paths to the source code files in the Access Paths target settings panel.

4. Choose **Project > Debug** to begin debugging the application.

NOTE When you debug a `.eld` file without a project, the IDE sets the **Build before running** setting on the Build Settings panel of the IDE Preference panels to Never.

Consequently, if you open another project to debug after debugging a `.eld` file, you must change the **Build before running** setting before you can build the project.

System-Level Connect

You can use the CodeWarrior debugger to perform a system-level connect to a target board, either before or after downloading a program to a target board. After you connect to the target board, you can examine system registers and memory.

Perform a System-Level Connect

You can perform a system-level connect (by choosing **Debug > Connect**) anytime you have a Project window open and your target board is correctly connected.

The following steps describe how to connect in the context of developing and debugging code on a target board.

To perform a system-level connect:

1. Use the CodeWarrior debugger to download a program to the target board.
2. Choose **Project > Run** to run the program from the first breakpoint.

   (By default, the debugger sets a temporary breakpoint on the main function at program launch.)
3. Choose **Debug > Kill**.

   The debugger stops running.
4. Ensure that the Project window for the program you downloaded is selected.
5. Choose **Debug > Connect**.

   The debugger connects to the board.

   You now can examine registers and the contents of memory on the board.

Initialization File

The initialization file is a text file that tells the debugger how to initialize the hardware after reset but before downloading code. Use the initialization file commands to write values to various registers, core registers, and memory locations.

You must select the Use Initialization File checkbox and specify the name of the initialization file in the SC100 Debugger Target panel.

- [Example Initialization File]
- [Customizing an Initialization File and JTAG Initialization File for 8101 Hardware]
- [Setting the IMMR Value]
- [Initialization File Commands]

Example Initialization File

Listing 6.1 shows part of an 8101 initialization file named `8101_Initialization.cfg`, which resides in the following directory:

Windows *CodeWarrior_dir*`\StarCore_Support\Initialization_Files\RegisterConfigFiles`

Solaris *install_dir/CodeWarrior_ver_dir*`/starcore_support/Initialization_Files/RegisterConfigFiles`

You can customize the contents of `8101_Initialization.cfg` if needed.

Listing 6.1 Excerpt from an 8101 Initialization File

```
#-----------------------------------------------------------------
#  8101 Initialization File
#-----------------------------------------------------------------

writeAllmem16 0xf0010006 0xfbc3  #SYPCR

writemmr16 IMMR 0x1470
writemmr32 BCR 0x00800000
```

```
...
```

Customizing an Initialization File and JTAG Initialization File for 8101 Hardware

Two files define labels for 8101 registers. One uses ordinary data structures (`MMapQ001.h`); the other uses packed data structures (`msc8101.h`). You can customize either of the files if needed.

If you are using 8101 hardware, include either `MMapQ001.h` or `msc8101.h` in your project. (Alternatively, you can include a customized version of either file, if you previously created one.)

For Windows, `MMapQ001.h` resides in the following directory:

CodeWarrior_dir`\StarCore_Support\flash_programmer_support`

For the Solaris operating system, `MMapQ001.h` resides in the following directory:

install_dir/CodeWarrior_ver_dir`/starcore_support/flash_programmer_support`

For Windows, `msc8101.h` resides in the following directory:

CodeWarrior_dir`\Stationery\StarCore\Msc8101\C_Source_Big_Endian`

For the Solaris operating system, `msc8101.h` resides in the following directory:

install_dir/CodeWarrior_ver_dir`/CodeWarrior_IDE/(Project Stationery)/MSC8101/C_Source_Big_Endian`

Setting the IMMR Value

The IMMR register holds the base address for PPC-bus memory-mapped registers. You can write to memory-mapped registers by using either the register name or by referring to the address of the register.

The debugger uses the value of the IMMR to determine the address of other PPC-bus memory-mapped registers.

The debugger is aware of a change in the IMMR register only if you write to the IMMR register in the initialization file by name (not by address).

If you initialize the IMMR by address, the debugger behaves as if you left the IMMR unchanged. In that case, the debugger uses the default reset value for the IMMR register (`0xF0000000`) as the base address for PPC-bus memory-mapped registers when performing all other reads and writes to those registers.

(The only exception is if you previously changed the value of the IMMR register by name.)

Initialization File Commands

Several initialization file commands exist that allow you to:

- Write to a register or memory location of a group of devices in the JTAG chain (all devices in the chain not previously masked out using the `writeAllMask` command)
- Write to a register or memory location of a specified device in the JTAG chain
- Write to a register or memory location of a default device (specified in the SC100 Debugger Target panel of the current project) in the JTAG device chain

writeAllMask

This initialization file command masks certain devices in a JTAG chain so that the following commands do not write to them:

- `writeAllmmr32`
- `writeAllmem32`
- `writeAllmmr16`
- `writeAllmem16`
- `writeAllmmr40`
- `writeAllmmr8`
- `writeAllmmr64`
- `writeAllmem8`

The syntax of the command follows:

`writeAllMask mask_value`

For *`mask_value`*, specify a 32-bit value that indicates which JTAG devices to omit writing to.

Table 6.2 lists example mask values and which JTAG devices they mask.

Table 6.2 Example Mask Values

Mask Value	JTAG Devices Masked
`0x00000001`	0
`0x00000002`	1
`0x00000003`	0 and 1
`0x00000004`	2
`0x00000005`	2 and 0
`0x00000006`	2 and 3
`0x00000007`	3, 2 and 1
(and so on)	

writeAllmem8

This initialization file command writes 8 bits to a specified memory location on all devices on the JTAG chain (except those previously masked by the `writeAllMask` command).

The syntax of the command follows:

`writeAllmem8 memory_location value`

Specify *`value`* as a decimal or hexadecimal value.

writeAllmem16

This initialization file command writes 16 bits to a specified memory location on all devices on the JTAG chain (except those previously masked by the `writeAllMask` command).

The syntax of the command follows:

`writeAllmem16 memory_location value`

Specify *`value`* as a decimal or hexadecimal value.

writeAllmem32

This initialization file command writes 32 bits to a specified memory location on all devices on the JTAG chain (except those previously masked by the `writeAllMask` command).

The syntax of the command follows:

`writeAllmem32` *`memory_location value`*

Specify *`value`* as a decimal or hexadecimal value.

writeAllmem64

This initialization file command writes 64 bits to a specified memory location on all devices on the JTAG chain (except those previously masked by the `writeAllMask` command).

The syntax of the command follows:

`writeAllmem64` *`memory_location value`*

Specify *`value`* as a decimal or hexadecimal value.

writeAllmmr8

This initialization file command writes to a specified 8-bit memory-mapped register on all devices on the JTAG chain (except those previously masked by the `writeAllMask` command).

The syntax of the command follows:

`writeAllmmr8` *`memory_mapped_register value`*

Specify *`value`* as a decimal or hexadecimal value.

writeAllmmr16

This initialization file command writes to a specified 16-bit memory-mapped register on all devices on the JTAG chain (except those previously masked by the `writeAllMask` command).

The syntax of the command follows:

`writeAllmmr16` *`memory_mapped_register value`*

Specify *`value`* as a decimal or hexadecimal value.

writeAllmmr32

This initialization file command writes to a specified 32-bit memory-mapped register on all devices on the JTAG chain (except those previously masked by the `writeAllMask` command).

The syntax of the command follows:

`writeAllmmr32` *`memory_mapped_register value`*

Specify *`value`* as a decimal or hexadecimal value.

writeAllmmr40

This initialization file command writes to a specified 40-bit memory-mapped register on all devices on the JTAG chain (except those previously masked by the `writeAllMask` command).

The syntax of the command follows:

`writeAllmmr40` *`memory_mapped_register value`*

Specify *`value`* as a decimal or hexadecimal value.

writeAllmmr64

This initialization file command writes to a specified 64-bit memory-mapped register on all devices on the JTAG chain (except those previously masked by the `writeAllMask` command).

The syntax of the command follows:

`writeAllmmr64` *`memory_mapped_register value`*

Specify *`value`* as a decimal or hexadecimal value.

writeDevicemem8

This initialization file command writes 8 bits to a specified memory location of a specified device on the JTAG chain.

The syntax of the command follows:

`writeDevicemem8` *`JTAG_index memory_location value`*

Specify *`value`* as a decimal or hexadecimal value.

writeDevicemem16

This initialization file command writes 16 bits to a specified memory location of a specified device on the JTAG chain.

The syntax of the command follows:

`writeDevicemem16` *`JTAG_index memory_location value`*

Specify *`value`* as a decimal or hexadecimal value.

writeDevicemem32

This initialization file command writes 32 bits to a specified memory location of a specified device on the JTAG chain.

The syntax of the command follows:

`writeDevicemem32` *`JTAG_index memory_location value`*

Specify *`value`* as a decimal or hexadecimal value.

writeDevicemem64

This initialization file command writes 64 bits to a specified memory location of a specified device on the JTAG chain.

The syntax of the command follows:

`writeDevicemem64` *`JTAG_index memory_location value`*

Specify *`value`* as a decimal or hexadecimal value.

writemem8

This initialization file command writes 8 bits to memory.

The syntax of the command follows:

`writemem8` *`memory_location value`*

Specify *`value`* as a decimal or hexadecimal value.

writemem16

This initialization file command writes 16 bits to memory.

The syntax of the command follows:

`writemem16` *`memory_location value`*

Specify *value* as a decimal or hexadecimal value.

writemem32

This initialization file command writes 32 bits to memory.

The syntax of the command follows:

`writemem32 memory_location value`

Specify *value* as a decimal or hexadecimal value.

writemem64

This initialization file command writes 64 bits to memory.

The syntax of the command follows:

`writemem64 memory_location value`

Specify *value* as a decimal or hexadecimal value.

writemmr8

This initialization file command writes to an 8-bit memory-mapped register.

The syntax of the command follows:

`writemmr8 memory_mapped_register value`

Specify *value* as a decimal or hexadecimal value.

writemmr16

This initialization file command writes to a 16-bit memory-mapped register.

The syntax of the command follows:

`writemmr16 memory_mapped_register value`

Specify *value* as a decimal or hexadecimal value.

writemmr32

This initialization file command writes to a 32-bit memory-mapped register.

The syntax of the command follows:

`writemmr32` *`memory_mapped_register value`*

Specify *`value`* as a decimal or hexadecimal value.

writemmr64

This initialization file command writes to a 64-bit memory-mapped register.

The syntax of the command follows:

`writemmr64` *`memory_mapped_register value`*

Specify *`value`* as a decimal or hexadecimal value.

writereg8

This initialization file command writes to an 8-bit core register.

The syntax of the command follows:

`writereg8` *`core_register value`*

Specify *`value`* as a decimal or hexadecimal value.

writereg16

This initialization file command writes to a 16-bit core register.

The syntax of the command follows:

`writereg16` *`core_register value`*

Specify *`value`* as a decimal or hexadecimal value.

writereg32

This initialization file command writes to a 32-bit core register.

The syntax of the command follows:

`writereg32` *`core_register value`*

Specify *`value`* as a decimal or hexadecimal value.

writereg40

This initialization file command writes to a 40-bit core register.

The syntax of the command follows:

`writereg40` *`core_register value`*

Specify *`value`* as a decimal or hexadecimal value.

Kernel Awareness

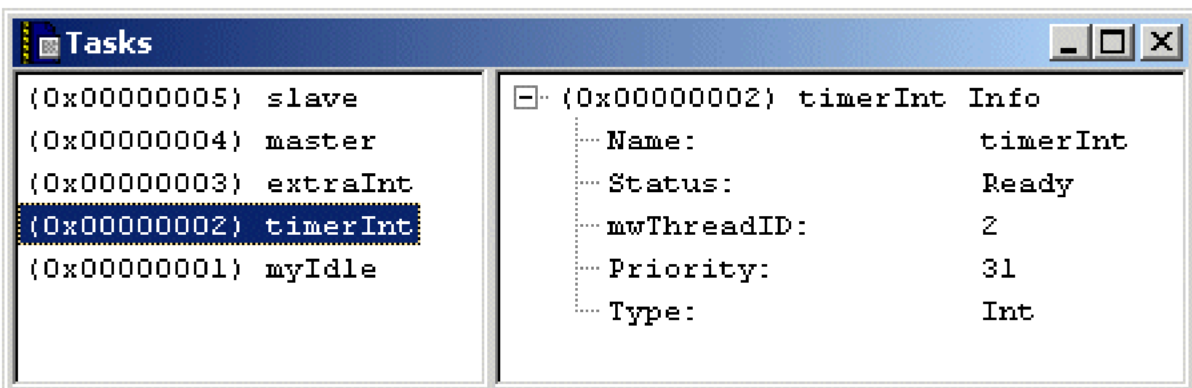
You can indicate that you are using a supported real-time operating system (RTOS) by selecting the RTOS on the Kernel Awareness pop-up menu of the SC100 Debugger Target panel.

If you are not using an RTOS, set the Kernel Awareness pop-up menu to None.

When you debug an application using the Enea OSE RTOS, the IDE displays a menu called OSE. This menu has one option, Task Info.

When you select Task Info from the OSE menu, the Tasks window (Figure 6.2) displays information about all the running tasks.

Figure 6.2 Tasks Window



Clicking a task name in the left pane of the Tasks window selects a task and causes the right pane of the window to display information relevant to the currently selected task.

Table 6.3 shows the Tasks window descriptors.

Table 6.3 Tasks Window Descriptors

Label	Description
Name	The name of the task.
Status	The current status of the task (for example, Ready, Running, or Stopped).

Table 6.3 Tasks Window Descriptors

Label	Description
mwThreadID	The ID number assigned to the task thread.
Priority	An integer value that indicates the priority for running a task.
Type	The type of the task. The possible values follow: • Prio — prioritized task • Bkgr — background task • Int — interrupt task • Time — timer interrupt task • Phan — phantom task • Kill — previously killed task • Illg — Invalid (illegal) task • Idle — idle task

Command-Line Debugging

In addition to using the regular CodeWarrior IDE debugger windows, you also can debug on the command-line. When you debug on the command-line, you can use:

- Commands included in the Tcl script language
- Additional debugging commands that are specific to the debugger

Tcl Support

This section describes how the command-line debugger handles Tcl support.

Automatically resolving clashing commands

Several command-line debugging commands clash with built-in Tcl commands. The command-line debugger resolves them as shown in Table 6.4 when the mode is set to auto.

Table 6.4 Resolving Clashing Commands

Command	Resolution
load	When you enter the command with one argument containing `.eld` or `.mcp`, the command-line debugger loads the project. Otherwise, the debugger calls the Tcl load command.
break	When you enter the command with no argument and in a script file, the command-line debugger calls the built-in Tcl break command. Otherwise, the debugger uses the break command to control breakpoints.
close	When you enter the close command with no argument, the command-line debugger closes the current debugging session. Otherwise, the debugger calls the built-in Tcl close command.

Tcl support for executing script files

Tcl usually executes a script file as one large block; Tcl returns only after the entire file executes. However, the `run` debugging command executes script files line by line. If a particular line is not a complete Tcl command, the `run` command appends the next line until it gets a complete Tcl script block.

For example, the Tcl `source` command executes the script in Listing 6.2 as one block, but the `run` debugging command executes it as two blocks: the `set` statement and the `while` loop.

Listing 6.2 Example Tcl Script

```
set x 0;

  while {$x < 5}

  {
    puts "x is $x";

    set x [expr $x + 1]

  }
```

NOTE The `run` debugging command synchronizes the debug events between blocks in a script file. For example, after a `go`, `next`, or `step` debugging command, `run` polls the debugging thread state

and refrains from executing the next line or block until the debugging thread stops.

However, the Tcl `source` command does not consider the state of the debugging thread. Consequently, use the `run` debugging command to execute script files that contain these debugging commands: `debug`, `go`, `next`, `stop`, and `kill`.

Tcl support for using a start-up script

You can use a start-up script with the command-line debugger. (You can specify command-line debugger commands in the script. For example, you might want to set an alias or a color configuration.)

Name the start-up script `tcld.tcl`. The command-line debugger executes the start-up script the first time you open the command-line debugger window, provided that the file is in the correct directory for the host platform you are using:

- For Windows, place `tcld.tcl` in the Windows NT installed directory.
- For Solaris, place `tcld.tcl` in your home directory.

NOTE There is no synchronization of debug events in the startup script. Consequently, add the `run` debugging command to the startup script and place the following debugging commands in another script to execute them: `debug`, `go`, `stop`, `kill`, `next`, and `step`.

Command-Line Debugging Tasks

This section describes some tasks for command-line debugging.

Open a Command-Line Debugging Window

To open a command-line debugging window, choose **Debug > Command Line Debugger**.

When the debugging window opens, it displays several command hints.

Enter a Single Command-Line Debugging Command

To enter a single debugging command:

1. Type a command (or its shortcut followed by a space) on the command line.

   (For example, the shortcut for the `break` command is `b`.)

2. If needed, type any options, separating them from the command and each other with spaces.

3. Press Enter.

Enter Multiple Command-Line Debugging Commands

To enter multiple debugging commands:

1. Decide which commands (Tcl and debugger-specific) to use.

2. Type the commands into a file.

3. Save the file with a `.tcl` extension to indicate that it is a Tcl script.

4. Enter the `run` command to run the script.

View Debugging Command Hints

You can view debugging command hints as follows:

- To view the hint for a particular debugger-specific command, type the command followed by a space.

  The hint shows the syntax for the remainder of the command.

- To view hints for all debugger-specific commands that you can use on the command line, press the space bar when the cursor is at the start of the command line in the debugging window.

Each hint highlights the minimum number of characters (shortcut) that you must type for the debugger to recognize the command. (Press the space bar after typing a shortcut for a command to complete the command automatically.)

Repeat a Command-Line Debugging Command

To reexecute a debugging command in the command-line debugging window:

1. Type the debugging command and press Enter.

   This executes the command the first time.

2. Press Enter again.

   This executes the same command again.

   Alternatively, type an exclamation point (!) followed by the ID number of the command and press Enter.

NOTE To see the ID numbers of commands, execute the `history` debugging command.

Review Previously Entered Commands

To sequentially review previously entered commands, press the Up-Arrow and Down-Arrow keys.

Clear a Command from the Command Line

To clear a command from the command line that you have typed but not yet executed, press the Escape key.

Stop an Executing Script

To stop a script that is executing, press the Escape key.

Switch between Insert and Overwrite Mode

To switch between insert and overwrite mode when entering commands on the command line, press the Insert key.

Scroll Text in the Command-Line Debugging Window

The scrolling line number can be set by the `config` debugging command.

To scroll text in the command-line debugging window:

- To scroll up one screenful of text, press the Page Up key.
- To scroll down one screenful of text, press the Page Down key.

NOTE By default, the number of lines scrolled by the Page Up and Page Down keys is the number of lines displayed in the debugging window. If you resize the window, the number of lines scrolled changes accordingly.

You also can use the debugger-specific `config` command to change the number of lines scrolled by the Page Up and Page Down keys.

- To scroll up one line of text, press Ctrl-Up-Arrow key.
- To scroll down one line of text, press Ctrl-Down-Arrow key.
- To scroll left one column, press Ctrl-Left-Arrow key.
- To scroll right one column, press Ctrl-Right-Arrow key.
- To scroll to the beginning of the displayed buffer, press Ctrl-Home.
- To scroll to the end of the displayed buffer, press Ctrl-End.

Copy Text from the Command-Line Debugging Window

To copy text from the window to the clipboard:

1 Drag your mouse over the text to copy.

2 Press Enter or choose **Edit > Copy**.

Paste Text into the Command-Line Debugging Window

To paste text from the clipboard into the window:

1 Place the mouse cursor on the command line.

2 Click the right mouse button or choose **Edit > Paste**.

Command-Line Debugging Commands

This section describes the command-line debugging commands.

alias

Use the `alias` debugging command to:

- Create a pseudonym for a debugging command
- Remove a pseudonym for a debugging command
- List all currently defined aliases

The syntax for the alias command follows:

`al[ias] [`*`alias_name`*`] [`*`alias_definition`*`]`

Table 6.5 shows examples of the `alias` command.

Table 6.5 Debugging Command Examples: alias

Example	Description
`alias .. cd ..`	This example creates a command named `..` to go to the parent directory.
`alias`	This example lists all the currently set aliases.
`alias ..`	This example removes a previously specified alias (named `..`).

break

Use the `break` debugging command to:

- Set a breakpoint
- Remove a breakpoint
- Display all currently set breakpoints

The syntax for the `break` command follows:

```
b[reak] [func_name | machine_addr] |
        [file_name line_num [column_number]] |
        [func_name | brkpt_num off]
```

Table 6.6 shows examples of the `break` command.

Table 6.6 Debugging Command Examples: break

Example	Description
`break foo`	This example sets a breakpoint on the function `foo`.
`break foo off`	This example removes the breakpoint from the function `foo`.
`break p:$1048a`	This example sets a breakpoint on the machine address `1048a`.
`break`	This example displays all the breakpoints.

Table 6.6 Debugging Command Examples: break (*continued*)

Example	Description
`break #4 off`	This example removes breakpoint number 4. (To determine the number assigned to a particular breakpoint, execute the `break` command.)
`break sc_main.c 15`	This example sets a breakpoint on line 15 in sc_main.c

bringtofront

Use the `bringtofront` debugging command to indicate whether to always display the command-line debugging window in front of all other windows on the screen.

The syntax for the `bringtofront` command follows:

```
bri[ngtofront] [on |off]
```

Table 6.7 shows examples of the `bringtofront` command.

Table 6.7 Debugging Command Examples: bringtofront

Example	Description
`bringtofront`	This example toggles the current `bringtofront` setting of the window.
`bringtofront on`	This example sets the command-line debugger window to always display in front of other windows.

cd

Use the `cd` debugging command to change to a different directory or display the current directory.

When typing a directory name, you can press the Tab key to complete the name automatically.

You can use an asterisk as a wild card when entering directory names.

The syntax for the `cd` command follows:

`cd [`*`path`*`]`

Table 6.8 shows examples of the `cd` command.

Table 6.8 Debugging Command Examples: cd

Example	Description
`cd`	This example displays the current directory.
`cd c:`	This example changes the directory to the root directory of the `C:` drive.
`cd d:/mw/0622/test`	This example changes the directory to the specified directory on the `D:` drive.
`cd c:/p*s`	This example uses a wild card character (*) to change the current directory to a different directory on the specified drive. For example, if there is a directory named `Program_Files` in the root directory of the `C:` drive, this example changes the current directory to that directory.

change

Use the `change` debugging command to change the contents of registers or memory locations.

You can change the contents of:

- A single register
- A block of registers
- A single memory address
- A block of memory addresses

The syntax for the `change` command follows:

```
c[hange] [ register | reg_block
         | address  | addr_block ]
         [ value ]
         [ 8bit |16bit | 32bit | 64bit ]
```

```
reg_block ::= register_first..register_last
```

```
addr_block ::= address_first..address_last |
                  address#count
```

count ::= a value indicating the number of memory locations whose contents to change

NOTE You cannot change some memory locations or registers when using a hardware board (for example, ROM memory).

Table 6.9 shows examples of the `change` command.

Table 6.9 Debugging Command Examples: change

Example	Description
`change R1 $123`	This example changes the contents of `R1` to `123`.
`change R1..R5 $5432`	This example changes the contents of `R1` through `R5` to `5432`.
`change p:10..17 3456`	This example changes memory address `10` through `17` to `3456`.
`change p:18..1f $03456`	This example changes memory addresses `18` through `1f` to `00003456`.

When you change the contents of one or more memory locations, you do not have to specify the memory access mode (whether the mode is eight-bit, 16-bit, 32-bit, or 64-bit).

If you do not specify the memory access mode, the debugger determines it as follows:

- If *`value`* is a fractional value, the mode is 16-bit.
- If *`value`* is a hexadecimal value, the debugger determines the mode as shown in Table 6.10:

Table 6.10 Memory Access Mode for Hexadecimal Values

Memory Access Mode	When value Length Is...	Examples
Eight-bit (8bit)	`length <= 2`	`$1`, `$12`, `$01`
16-bit (16bit)	`2 < length <= 4`	`$0001`, `$123`
32-bit (32bit)	`4 < length <= 8`	`$00000123`, `$1234567`
64-bit (64bit)	`length > 8`	`$123456789`

- If *`value`* is a decimal value, the debugger determines the mode as shown in Table 6.11:

Table 6.11 Memory Access Mode for Decimal Values

Memory Access Mode	When value Is...	Examples
Eight-bit (8bit)	`value <= 0xff`	`0,54,255`
16-bit (16bit)	`value > 0xff`	`256,65535,1000`
32-bit (32bit)	`0xffff < value <= 0xffffffff`	`65536,3253532`
64-bit (64bit)	`value > 0xffffffff`	`4294967296`

cls

Use the `cls` debugging command to clear the command-line debugging window.

The syntax for the `cls` command follows:

```
cl[s]
```

close

Use the `close` debugging command to close the opened default project.

The syntax for the `close` command follows:

```
clo[se]
```

config

Use the `config` debugging command to configure the command-line debugging window. You can configure these items:

- Window colors
- Scrolling size
- Mode
- The default build target
- The hexadecimal prefix
- The memory identifier
- The processor name
- The subprocessor name

In addition, you can perform these actions:

- Get the default build target name
- Get the default project name

The syntax for the `config` command follows:

```
conf[ig]
  [ c[olor] [r | m | c | s | e | n]
        text_color  [background_color]  |
   m[ode]  [ dsp | tcl | auto] |
   s[croll] number_of_lines  |
   h[exprefix]  hexadecimal_prefix  |
   mem[identifier]  memory_identifier  |
   p[rocessor]  processor_name  [subprocessor_name] ]
```

text_color ::= [*R_value* *G_value* *B_value*]

background_color ::= [*R_value* *G_value* *B_value*]

R_value ::= the R value of an RGB color

G_value ::= the G value of an RGB color

B_value ::= the B value of an RGB color

NOTE The valid values to specify an RGB color are from 0 through 255.

number_of_lines ::= the number of lines to scroll

Table 6.12 shows examples of the `config` command.

Table 6.12 Debugging Command Examples: config

Example	Description
`config`	Display all current configuration status information.
`config c e $ff $0 $0`	Set the error text color to red.
`config c r $0 $0 $0 $ff $ff $ff`	Set the register display color to black and the background color to white.
`config s $10`	Set the page scrolling size to decimal 16 lines.
`config m dsp`	Set the command-line debugging window to dsp mode; use the command-line debugging commands when clashing.

Table 6.12 Debugging Command Examples: config (*continued*)

Example	Description
`config m tcl`	Set the command-line debugging window to Tcl mode; use the Tcl commands when clashing.
`config m auto`	Set the command-line debugging window to auto mode; resolve clashing automatically.
`config hexprefix 0x`	Show hexadecimal numbers with `0x` prefix.
`config memidentifier m`	Set the memidentifier to m.
`config processor 8101`	Set the processor to 8101.
`config target`	Get the default build target name.
`config project`	Get the default project name.
`config target debug release x86`	Change the default build target to `debug release x86`.

copy

Use the `copy` debugging command to copy the contents of a memory address or block of addresses to another memory location.

The syntax for the `copy` command follows:

`co[py]` *addr_group* *`addr`*

addr_group `::=` *`address`* | *addr_block*

addr_block `::=` *`address_first..address_last`* |
`address#count`

count ::= a value indicating the number of memory locations

The *addr_group* symbol is the location (or locations) from which the command copies the contents. The *`addr`* variable specifies the first address in memory to which the command copies the contents.

Table 6.13 shows examples of the `copy` command.

Table 6.13 Debugging Command Examples: copy

Example	Description
`copy p:00..1f p:30`	This example copies the contents of memory addresses `00` through `1f` to a contiguous block of memory beginning at address `30`.
`copy p:20#10 p:50`	This example copies the contents of 10 consecutive memory locations that start at address `20` to a contiguous block of memory beginning at address `50`.

debug

Use the `debug` command to start a command-line debugging session for a project.

The syntax for the `debug` command follows:

`de[bug] [`*`project_file_name`*`]`

Table 6.14 shows examples of the `debug` command.

Table 6.14 Debugging Command Examples: debug

Example	Description
`debug`	This example starts a debugging session for the open default project.
`debug des.mcp`	This example starts a debugging session for the project named `des.mcp`.

dir or ls

Use the `dir` debugging command to list the contents of a directory when developing on a Windows host. Use the same syntax that you use for the operating system `dir` command.

Use the `ls` debugging command to list the contents of a directory when developing on a Solaris host. Use the same syntax that you use for the operating system `ls` command.

NOTE You can use the `dir` debugging command the same way you use the `dir` OS command with one exception. You cannot use any

option that requires user input from the keyboard (such as `/p` for the `dir` OS command).

Table 6.15 shows examples of the `dir` and `ls` commands.

Table 6.15 Debugging Command Examples: dir

Example	Description
`dir`	This example lists all files in the current directory.
`di *.txt`	This example lists all files in the current directory that have a file extension of `.txt`.
`dir c:/tmp`	This example lists all files in the `tmp` directory of the `C:` drive.
`dir /ad`	This example lists only the subdirectories in the current directory.
`ls /usr`	This example lists the contents of the subdirectory called `usr`.

disassemble

Use the `disassemble` debugging command to disassemble the instructions in the specified memory block.

The syntax for the `disassemble` command follows:

`di[sassemble]` *addr_block*

addr_block `::=` *`address_first..address_last`* |
`address#count`

count ::= a value indicating the number of memory locations

Table 6.16 shows examples of the `disassemble` command.

Table 6.16 Debugging Command Examples: disassemble

Example	Description
`disassemble`	Disassembles instructions from PC (if changed)/last address.

Table 6.16 Debugging Command Examples: disassemble (*continued*)

Example	Description
`disassemble p:0..20`	Disassembles program memory address block 0 to 20.
`disassemble p:$50#10`	Disassembles 10 memory locations starting at memory map hexadecimal 50.

display

Use the `display` debugging command to:

- Display the contents of a register or memory location
- List all the register sets on a target
- Add one or more register sets, registers, or memory locations to the default display items
- Remove one or more register sets, registers, or memory locations from the default display items

The memory output radix is specified by the `radix` command.

When you display registers or memory locations, the `display` command returns the values to Tcl. Consequently, you can embed the display command to Tcl as follows:

```
set r0 [display r0]           ; puts $r0 ;
set r0M [display p:$r0 32bit] ; puts $r0M
set r0r1 [display r0..r1]     ; puts $r0r1 ;
```

By default, the `display` command displays memory as 16-bits per unit; you can change that by specifying unit size as `8bit`, `16bit`, `32bit`, `64bit`.

The syntax for the `display` command follows:

```
d[isplay] [ regset ] |
 [on all] |
 [off all] |
 [off id_number ] |
 [on reg_group | reg_block | addr_group [8bit | 16bit | 32bit | 64bit]] |
 [off reg_group | reg_block | addr_group [8bit | 16bit | 32bit | 64bit]]
```

reg_group `::=` a list of register sets separated by spaces

reg_block `::= register_first..register_last`

addr_group `::= address` | *addr_block*

addr_block `::= address_first..address_last |`
`address#count`

count ::= a value indicating the number of memory locations

You can specify the following register sets as part of a *reg_group*:

`GPR, SIM, EONCE, GEN_SIU, MEM_CTRL, SYS_INT_TIM, DMA, INT_CTRL, ClocksReset, IOPort, CPMTimers, SDMAGen, IDMA, FCC, BRG, I2C, SP, SCC, SMC, SPI, CPMMux, SI, MCC, HDI16, EFCOP, PIC, QBUS, ALL`

Table 6.17 shows examples of the `display` command.

Table 6.17 Debugging Command Examples: display

Example	Description
`display`	Displays the default items (for example, register sets). The command-line debugger executes the display command whenever program execution stops.
`display on`	Lists the default display items.
`display regset`	Lists all the available register sets on the target chip.
`display on EONCE QBUS`	Add the EONCE and QBUS register sets to the default display items.
`display off SIM`	Remove the SIM register set from the default display items.
`display on ALL`	Add all supported register sets to the default display items.
`display on p:230#10`	Add the specified memory locations to the default display items.
`display off p:230#10`	Remove the specified memory locations from the default display items.
`display off all`	Remove all the items from the default display items.
`display off #2`	Remove the item whose ID is 2 from the default display items.
`display R1`	Lists the value of register R1 and returns to Tcl.

Table 6.17 Debugging Command Examples: display (*continued*)

Example	Description
`display R1..R5`	Lists the contents of registers R1 through R5.
`display p:00..$100`	Displays the memory contents from address 0 to hexadecimal 100.
`display p:00#$200 8bit`	Display hexadecimal 200 memory units' contents from address 0. Access memory in 8bit mode.

evaluate

Use the `evaluate` debugging command to display a C variable type or value.

The syntax of the `evaluate` command follows:

`e[valuate] [ b | d |f | h | u]` *`variable`*

The following list defines the options for the first parameter, `[ b | d | f | h  | u ]`, as follows:

- `b` = binary
- `d` = decimal
- `f` = fraction
- `h` = hex
- `u` = unsigned

The preceding parameter defines the format in which to display the value of the variable.

Table 6.18 Debugging Command Examples: evaluate

Example	Description
`evaluate`	Lists the types for all the variables in the current and global stack.
`evaluate i`	Returns the value of the variable `i`.

exit

Use the `exit` debugging command to close the command-line debugging window.

The syntax for the `exit` command follows:

`[ex]it`

go

Use the `go` debugging command to start the program that you are debugging from the current instruction.

The syntax for the `go` command follows:

g[o] [all | *time_period*]

If you execute the `go` command interactively, the command returns immediately. The target program starts to run.

Then you can either wait for the target program to stop executing (for example, on a breakpoint) or type the `stop` debugging command to stop the execution of the target program.

If you execute the `go` command in a script, the command-line debugger polls until the debugger stops (for example, on a breakpoint) and then executes the next command in the script. (If the command-line debugger continues polling indefinitely because the debugging process does not stop, you can stop the script by pressing the Escape key.)

Table 6.19 shows examples of the `go` command.

Table 6.19 Debugging Command Examples: go

Example	Description
`go`	This command returns immediately. The program stops at the first occurrence of a breakpoint. You also can use the `stop` debugging command to break the program.
`go 1`	This command stops polling the target when no breakpoint is reached within 1 second. It also sets a Tcl variable called `$still_running` to 1.
`go all`	This command starts all the target programs when debugging multiple cores.

help

Use the `help` debugging command to display help for the debugging commands in the command-line debugger window.

The syntax for the `help` command follows:

h[elp] [*command* | *command_shortcut*]

Table 6.20 shows examples of the `help` command.

Table 6.20 Debugging Command Examples: help

Example	Description
`help`	This example lists all the debugging commands.
`help b`	This example displays help for the `break` debugging command.

history

Use the `history` debugging command to list the history of the commands entered during the current debugging session.

The syntax for the `history` command follows:

`hi[story]`

hsst_attach_listener

Use the `hsst_attach_listener` command to set up a Tcl procedure that the debugger notifies whenever there is data in an communication channel.

The syntax for `hsst_attach_listener` command follows:

`hsst_a[ttach_listener]` *`channel_id tcl_proc_name`*

The following example uses the `hsst_attach_listener` command to execute the procedure `call_back` automatically when a communication channel has data available from the target.

```
proc call_back { } {
 global hsst_descriptor;
 global hsst_nmemb;
 global hsst_size;
 puts [ hsst_read $hsst_size $hsst_nmemb
$hsst_descriptor ]
}
set cid [ hsst_open channel1 ]
hsst_attach_listener $cid call_back;
```

hsst_block_mode

Use the `hsst_block_mode` command to configure a communication channel in blocking mode. Doing so causes all calls

to `hsst_read` to block until the requested amount of data is available from the target.

The default setting is for all channels to be in blocking mode.

The syntax for `hsst_block_mode` follows:

`hsst_b[lock_mode]` *`channel_id`*

The following example configures a channel in blocking mode:

```
hsst_block_mode $cid
```

hsst_close

Use the `hsst_close` debugging command to close a communication channel with the host machine.

The syntax for the `hsst_close` command follows:

`hsst_c[lose]` *`channel_id`*

The following example closes a channel and sets the result to the variable `$cid`:

```
hsst_close $cid
```

hsst_detach_listener

Use the `hsst_detach_listener` command to detach a listener that had been previously attached for automatic data notification.

The syntax for `hsst_detach_listener` follows:

`hsst_d[etach_listener]` *`channel_id`*

The following example detaches a listener that previously was attached:

```
hsst_detach_listener $cid
```

hsst_log

Use the `hsst_log` debugging command to log the data to a directory.

The syntax for the `hsst_log` command follows:

`hsst_l[og] [` *`directory_name`* `]`

Table 6.33 shows examples of the `hsst_log` command:

Table 6.21 Debugging Command Examples: hsst_log

Example	Description
`hsst_log c:\logdata`	The debugger logs the data to the specified directory.
`hsst_log`	The debugger turns off the log.

hsst_noblock_mode

Use the `hsst_noblock_mode` command to configure a communication channel in non-blocking mode. Dong so causes all calls to `hsst_read` to return immediately with any available data (limited by the requested size).

The syntax for `hsst_noblock_mode` follows:

`hsst_n[oblock_mode]` *`channel_id`*

The following example configures a channel in non-blocking mode:

```
set cid [ hsst_open channel1 ]
hsst_noblock_mode $cid
```

hsst_open

Use the `hsst_open` debugging command to open a communication channel with the host machine.

The syntax for the `hsst_open` command follows:

`hsst_o[pen]` *`channel_name`*

The following example opens a channel and sets the returned ID to the variable `$cid`:

```
set cid [hsst_open ochannel1]
```

hsst_read

Use the `hsst_read` debugging command to read data from an opened communication channel.

The syntax for the `hsst_read` command follows:

`hsst_r[ead]` *`size nmemb cid`*

The following example uses the `hsst_read` command to read 15 data items (each 1 byte in length) from the channel identified by the variable `$cid`:

```
puts [hsst_read 1 15 $cid]
```

The debugger returns and displays the data.

hsst_write

Use the `hsst_write` debugging command to write data to an opened communication channel.

The syntax for the `hsst_write` command follows:

```
hsst_w[rite] size data cid
```

The following example uses the `hsst_write` command to write `0x1234` as 2 bytes of data to the channel identified by the variable `$cid`:

```
hsst_write 2 0x1234 $cid
```

input

Use the `input` debugging command to map a target memory block to a host file. When a target application reads the memory block, the application reads the contents of the specified host file instead.

The syntax for the `input` command follows:

```
i[nput]
[ id_num | address filename
[ -rd | -rf | -rh | -ru ]] |
[ off ]
```

Specify *`address`* when using the simulator to debug. Specify *`id_num`* when using target hardware to debug.

Choose from the following options to indicate the format of the input file:

- Use `-rd` to indicate that the input file is a decimal file.
- Use `-rf` to indicate that the input file is a fractional file.
- Use `-rh` to indicate that the input file is a hexadecimal file.
- Use `-ru` to indicate that the input file is an unsigned decimal file.

Table 6.22 shows examples of the `input` command.

Table 6.22 Debugging Command Examples: input

<table>
<tr><th>Example</th><th>Description</th></tr>
<tr><td><code>input p:$100 in.dat -RD</code>

(This example is valid only for the simulator.)</td><td>This example sets up the input feature so that the simulator gets values from the <code>in.dat</code> file in decimal format (specified by <code>-RD</code>) and places them in a memory block <code>p:$100</code> when the target application reads <code>p$100</code>.</td></tr>
<tr><td><code>input #1 in.dat -RF</code>

(This example is valid only for debugging hardware.)</td><td>This example maps file ID <code>1</code> (<code>0</code> through <code>255</code> are valid values) to the file <code>in.dat</code> in fractional format (specified by <code>-RF</code>). In addition, you must add some special assembly code in your target application where you want to read values from <code>in.dat</code> to target memory.

The following example reads 32 words from a file to memory located at <code>#INPUT</code>:

<pre>; Set special value in D0 to
; indicate this is for INPUT/OUTPUT.
; The D0 will be reset after the
; debug instruction.
move.w #$4d43,d0.l
move.w #$5343,d0.h

; fileID : #1 (assigned by
; output command)
; block : 32 words
move.w #$0120,b0

; Mem address to write contents debug
move.l   #INPUT,r0

; use debug as the trigger to have
; the input command copy data from
; the host file to target memory
debug</pre></td></tr>
<tr><td><code>input off</code></td><td>This example closes all input files and stops the input feature. (The command is the same both when debugging with the simulator or with target hardware.)</td></tr>
<tr><td><code>input</code></td><td>This example lists all the input/output files that are open. (The command is the same both when debugging with the simulator or with target hardware.)</td></tr>
</table>

kill

Use the `kill` debugging command to close one or all current debugging sessions.

The syntax for the `kill` command follows:

`k[ill] [all]`

Table 6.24 shows examples of the `kill` command.

Table 6.23 Debugging Command Examples: kill

Example	Description
`kill`	Kills the current debugging session.
`kill all`	Kills all the debug sessions when debugging multiple cores.

load

Use the `load` debugging command to open a project or load records into memory.

The syntax for the `load` command follows:

`l[oad]` *`project_file_name`* `|` *`eld_file_name`*

or

`l[oad] -h | -b` *`file_name`* `[` *`memory_location`* `]`

The following list defines the first parameter of the second version of the load command:

- `-h` = hexadecimal file
- `-b` = binary file

Table 6.24 shows examples of the load command.

Table 6.24 Debugging Command Examples: load

Example	Description
`load des.mcp`	Loads a project named `des.mcp`.
`load des.eld`	Creates a default project from the `des.eld` object file and loads the project.

Table 6.24 Debugging Command Examples: load (*continued*)

Example	Description
`load -h dat.lod`	Loads the contents of the hexadecimal file `dat.lod` into memory.
`load -b dat.lod p:$20`	Loads the contents of the binary file `dat.lod` into memory begin at `$20`.

log

Use the `log` debugging command to log either the commands that you enter during a debugging session or the entire session (all display entries) during a debugging session.

The syntax for the `log` command follows:

`lo[g] [off] [c | s` *`file_name`*`]`

Table 6.25 shows examples of the `log` command.

Table 6.25 Debugging Command Examples: log

Example	Description
`log`	This example displays a list of currently opened log files.
`log s session.log`	This example logs all display entries to a file named `session.log`.
`log c command.log`	This example logs the commands that you enter during the debugging session to a file named `command.log`
`log off c`	This example ends command logging.
`log off`	This example ends all logging in the command-line debugging window.

next

Use the `next` debugging command to step over subroutine calls.

If you execute the `next` command interactively, the command returns immediately. The target program starts to run.

Then you can either wait for the target program to stop executing (for example, on a breakpoint) or type the `stop` debugging command to stop the execution of the target program.

If you execute the `next` command in a script, the command-line debugger polls until the debugger stops (for example, on a breakpoint) and then executes the next command in the script. (If the command-line debugger continues polling indefinitely because the debugging process does not stop, you can stop the script by pressing the Escape key.)

The syntax for the `next` command follows:

```
n[ext]
```

output

Use the output debugging command to map a target memory block to a host file. When the target application writes to the memory block, the application writes the contents to the specified file instead.

The syntax for the `output` command follows:

```
o[utput]
[ id_num | address filename
[ -rd | -rf | -rh | -ru ] [-a/-o] ] |
[ off ]
```

Specify *`address`* when using the simulator to debug. Specify *`id_num`* when using target hardware to debug.

Choose from the following options to indicate the format of the output file:

- Use `-rd` to indicate that the output file is a decimal file.
- Use `-rf` to indicate that the output file is a fractional file.
- Use `-rh` to indicate that the output file is a hexadecimal file.
- Use `-ru` to indicate that the output file is an unsigned decimal file.

Choose from the following options to indicate how to write to the output file:

- Use `-a` to cause the debugger to append to the output file if it already exists.

- Use `-o` to cause the debugger to overwrite the output file if it already exists.

Table 6.26 shows examples of the output command.

Table 6.26 Debugging Command Examples: output

Example	Description

`output #2 out.dat -RF -O`
 	
(This example is valid only for debugging hardware.)
	This example maps file ID `2` (the values `0` through `255` are valid) to the file `out.dat` in fractional format (indicated by `-RF`). The `-O` option causes the debugger to overwrite the `out.dat` file if the file already exists.
	
	In addition, you must add some special assembly code to your target application where you want to write the target memory block to the file `out.dat`.
	
	The following example writes 32 words located at #OUTPUT to the file `out.dat`:
	
	`move.w #$4d43,d0.l`
	
	`; Set special value in D0`
	`; to indicate this is`
	`; for INPUT/OUTPUT, the D0`
	`; will be reset after debug`
	`; instruction`
	`move.w #$5343,d0.h`
	
	`; fileID : #2 (assigned by`
	`; output command)`
	`; block : 32 words`
	`move.w #$0220,b0`
	
	`; Mem address to read`
	`; contents debug`
	`move.l   #OUTPUT,r0`
	
	`; use debug as the trigger to have`
	`; the input command copy data from`
	`; target memory to the host file`
	`debug`

`output p:$0 out.dat -RD -A` (This example is valid only for the simulator.)	This example stores values (which are written to the memory location `p:0` by the target application) to the file out.dat in decimal format (indicated by `-RD`). The `-A` option appends the values to file `out.dat` if the file already exists.

Table 6.26 Debugging Command Examples: output (*continued*)

Example	Description
`output off`	This example closes all output files and stops the output feature.
`output`	This example lists all the input/output files that are open.

pwd

Use the `pwd` debugging command to display the working directory.

The syntax for the `pwd` command follows:

```
pwd
```

radix

Use the `radix` debugging command to:

- Display the current default input radix (number base)
- Change the default number base for command entry or for display of registers and memory locations.

Changing the default input radix allows you to enter constants in the chosen radix without typing a radix specifier before each constant.

By default, the command-line debugger uses hexadecimal as the input radix and display radix unless you change them.

NOTE You can override the default input radix when entering an individual value. To specify a hexadecimal constant, precede the constant with a dollar sign ($). To specify a decimal constant, precede the constant with a grave accent. To specify a binary value, precede the constant with a percent sign (%). To specify a fraction value, precede the constant with a caret (^).

The syntax for the `radix` command follows:

`r[adix] [b | d | f | h | u]`
`[ register |` *reg_block* `|` *addr_group* `]...`

The following list defines the first parameter, `[ b | d | f | h | u ]`, as follows:

- `b = ` binary

- `d` = decimal
- `f` = fraction
- `h` = hex
- `u` = unsigned

The preceding parameter, when not followed by register names or memory locations, specifies the radix to use as the default input radix. When followed by register names or memory locations, the radix is the default display radix when displaying the values contained in the specified register or memory location.

reg_block `::=` *`register_first..register_last`*

addr_group `::=` *`address`* | *addr_block*

addr_block `::=` *`address_first..address_last`* |
`address#count`

count `::=` a value indicating the number of memory locations

If you enter the `radix` command without any parameters, the debugging window displays the current default input radix.

Table 6.27 shows examples of the `radix` command.

Table 6.27 Debugging Command Examples: radix

Example	Description
`radix`	Displays the currently enabled radix.
`radix D`	Changes the input radix to decimal.
`radix H`	Changes the input radix to hexadecimal.
`radix f r0..r7`	Changes the display radix for the specified registers to fraction.
`radix d x:0#10 r1`	Changes the display radix for the specified register and memory blocks to decimal.

restart

Use the `restart` debugging command to restart the debugging session.

The syntax for the `restart` command follows:

```
[re]start
```

run

Use the `run` debugging command to execute a Tcl script.

This command executes a script file block by block.

NOTE You can use the `run` command to run a script that includes these commands: `load`, `close`, `debug`, `kill`, and `run`. However, the preceding commands cannot reside in a block (such as a loop).

For example, this script is invalid:

```
set x 0
while {$x < 5}
{
load a.mcp
debug
kill
}
```

The syntax for the `run` command follows:

`ru[n]` *`file_name`*

The following example executes a file named `test.tcl`:

```
run test.tcl
```

save

Use the `save` debugging command to save the contents of specified memory locations to a binary file or a text file in hexadecimal format.

The syntax for the `save` command follows:

`sa[ve] -h | -b` *addr_block* `... filename [-a | -c | -o]`

addr_block `::=` *`address_first..address_last`* `|`
`address#count`

count ::= a value indicating the number of memory locations

The following list defines the first parameter to the `save` command:

- `-h` = write a text file in hexadecimal format

  When you save to a file in hexadecimal text format, the debugger saves the memory location information in the file.

Consequently, when you load a file saved in this format, you do not have to specify the memory address.

- `-b` = write a binary file

  When you save to a binary file, the debugger does not save the memory location information in the file. Consequently, when you load a file saved in this format, you must specify the memory address.

The following list defines the last parameter to the `save` command:

- `-a` = append to an existing file
- `-c` = write if the file does not yet exist

  If the file to which you are trying to save already exists, the `save` command does not overwrite the file. Instead, the `save` command cancels and returns without changing the file.

- `-o` = overwrite an existing file

You can use the Tcl `set` command to assign a name to a particular block of memory. You can then substitute that name instead of typing the specification for the memory block repeatedly.

Table 6.28 shows examples of the `save` command.

Table 6.28 Debugging Command Examples: save

Example	Description
`set addressBlock1 "p:10..`31"` `set addressBlock2 "p:10000#20"` `save -h $addressBlock1 $addressBlock2 hexfile -a`	Dumps the contents of two memory blocks to a text file called `hexfile.lod` in append mode.
`set addressBlock1 "p:10..`31"` `set addressBlock2 "p:10000#20"` `save -b $addressBlock1 $addressBlock2 binfile -o`	Dumps the contents of two memory blocks to a binary text file called `binfile.lod` in overwrite mode.

step

Use the `step` debugging command to step through a program.

The debugger automatically executes the `display` debugging command each time that you invoke the `step` command.

The syntax for the `step` command follows:

`st[ep] [li | in | into | out]`

Table 6.29 shows examples of the `step` command.

Table 6.29 Debugging Command Examples: step

Example	Description
`step li`	This example steps one line.
`step in`	This example steps one instruction.
`step into`	This example steps into a function.
`step out`	This example steps out of a function.

stop

Use the `stop` debugging command to stop a running program after invoking a `go`, `step`, or `next` debugging command.

The syntax for the `stop` command follows:

`s[top] [all]`

Table 6.24 shows examples of the `stop` command.

Table 6.30 Debugging Command Examples: kill

Example	Description
`stop`	Stops the currently running target program.
`stop all`	Stops all currently running target programs when debugging multiple cores.

switchtarget

When you are performing multi-core or multi-chip debugging, use the `switchtarget` debugging command to list the available debugging sessions and to specify to which session you want to send subsequent debugging commands.

The syntax for the `switchtarget` command follows:

`sw[itchtarget] [`*`index`*`]`

Table 6.31 shows examples of the `switchtarget` command.

Table 6.31 Debugging Command Examples: switchtarget

Example	Description
`switchtarget`	This example lists the currently available debugging sessions.
`switchtarget 0`	Choose the debugging session whose session ID is `0` to send subsequent debugging commands to.

system

Use the `system` debugging command to execute a system command.

NOTE The command-line debugger supports executing system commands that require keyboard input. However, the command-line debugger does not support commands that use the full screen display (such as the DOS edit command).

The syntax for the `system` command follows:

`sy[stem]` *`system_command`*

The following example runs a system command that deletes all files in the current directory with the `.tmp` file extension:

```
system del *.tmp
```

view

Use the `view` debugging command to change the view mode. You can toggle the view mode between assembly mode and register mode.

The syntax for the `view` command follows:

```
v[iew] [a | r]
```

Table 6.32 shows examples of the `view` command.

Table 6.32 Debugging Command Examples: view

Example	Description
`view`	Toggle the view mode.
`view a`	Set the view mode to assembly mode.
`view r`	Set the view mode to register mode.
`view a $100`	Display the assembly that begins at hexadecimal address `100`.

wait

Use the `wait` debugging command to cause the debugger to wait for the specified amount of time.

The syntax for the `wait` command follows:

`w[ait] [`*`milliseconds`*`]`

Table 6.33 shows examples of the `wait` command:

Table 6.33 Debugging Command Examples: wait

Example	Description
`wait`	The debugger waits until you press the space bar on the keyboard.
`wait 2`	The debugger waits for two milliseconds.

watchpoint

Use the `watchpoint` debugging command to add, remove, or display a watchpoint.

NOTE Due to hardware resource limitations, you can set only one watchpoint at a time.

The syntax for the `watchpoint` command follows:

`wat[chpoint] [`*`variable_name`*` | `*`watchpoint_id`*` off]`

Table 6.33 shows examples of the `watchpoint` command:

Table 6.34 Debugging Command Examples: watchpoint

Example	Description
`watchpoint`	The debugger displays the watchpoint list.
`watchpoint i`	The debugger add the variable `i` to the watchpoint list.

Load Save Fill Memory

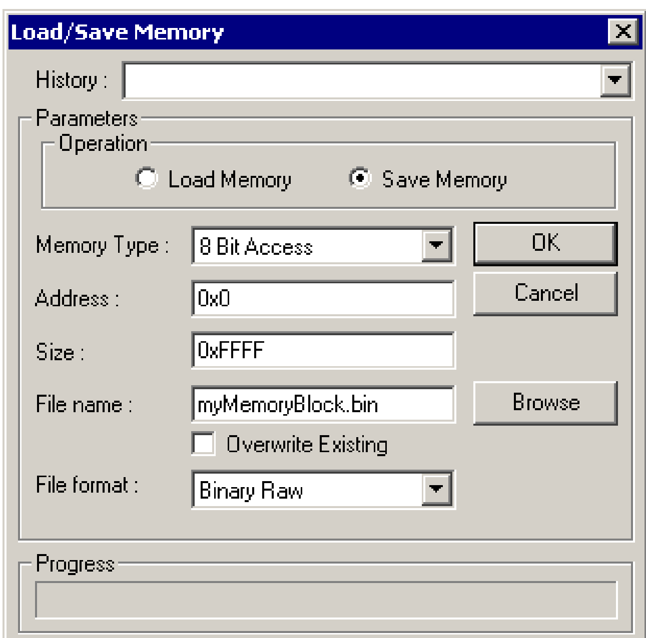
There are two options under the Debug menu that let you edit the contents of target memory while you are debugging.

- Load/Save Memory
- Fill Memory

Load/Save Memory

To load or save the contents of your target memory, select **Debug > Load/Save Memory**. The Load/Save Memory dialog box appears (Figure 6.3).

Figure 6.3 Load/Save Memory Dialog Box



History

The **History** list box lists all previous load and save memory operations. Select a previous load or save operation to repeat the action.

Operation

The **Operation** radio buttons let you select between load operations and save operations.

Memory Type

The **Memory Type** list box lets you select the size of the memory units. You can select from:

- 8-bit access
- 16-bit access
- 32-bit access

Address

The **Address** text field lets you specify the memory address where you want to start loading or saving memory.

Size

The **Size** text field lets you specify the size in bytes of the memory region you want to load or save.

Filename

The **Filename** text field lets you specify the file you wish to use for the desired memory operation.

Overwrite Existing

The **Overwrite Existing** checkbox lets you specify that you wish to overwrite any existing files. This option is only available when you are performing Save operations.

File Formats

The **File Formats** list box lets you specify the format of the data within the file. You can select from:

- Binary Raw

a binary file containing an uninterrupted stream of data

- Text Decimal

  a text file in which each memory unit is represented by a signed decimal value.

- Text Fixed

  a text file in which each memory unit is represented by a 32-bit fixed point value.

- Text Fractional

  a text file in which each memory unit is represented by a floating point number.

- Text Hex

  a text file in which each memory unit is represented by a hexadecimal value.

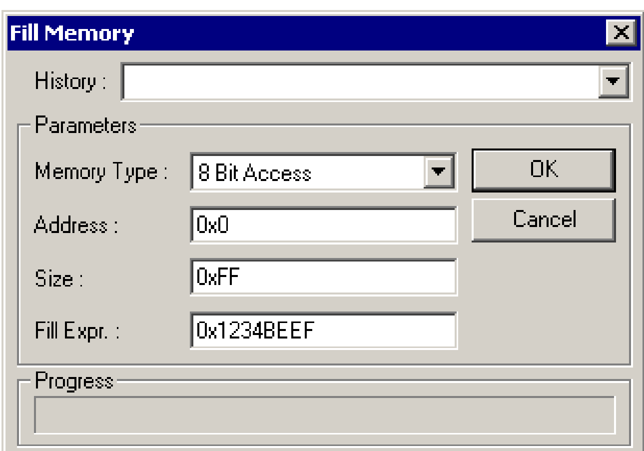
- Text Unsigned Decimal

  a text file in which each memory unit is represented by an unsigned decimal value

Fill Memory

To fill a memory region of your target with a given value, select **Debug > Fill Memory**. The **Fill Memory** dialog box appears (Figure)

Figure 6.4 Fill Memory Dialog Box



History

The **History** list box lists all the previous fill operations. Select a previous fill operation to repeat the action.

Memory Type

The **Memory Type** list box lets you select the size of the memory units. You can select from:

- 8-bit access
- 16-bit access
- 32-bit access

Address

The **Address** text field lets you specify the memory address where you want to start filling target memory.

Size

The **Size** text field lets you specify the size in bytes of the memory region you want to fill.

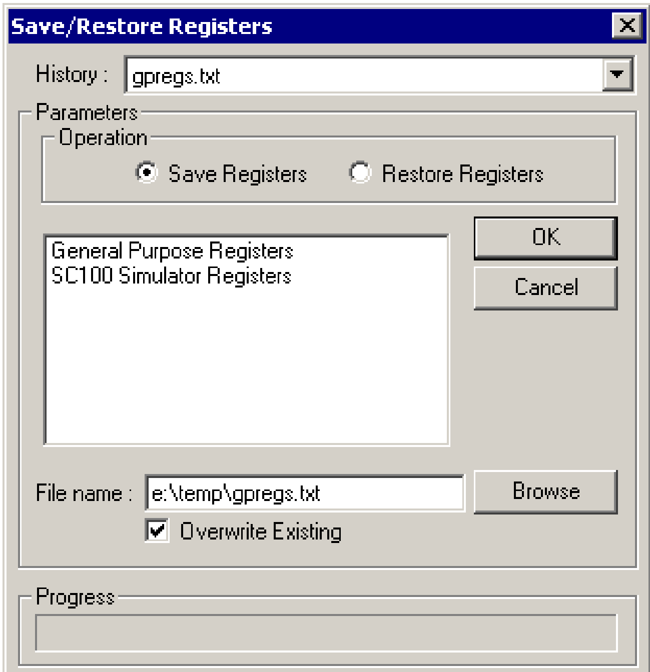
Fill Expr

The **Fill Expr** text field lets you specify the hexadecimal value with which you want to fill the memory region.

Save Restore Registers

The **Debug > SaveRestoreRegs** option (Figure 6.5) lets you save or restore the values of register banks while you are debugging.

Figure 6.5 Save/Restore Registers Dialog Box



History

The **History** list box lists all previous save and restore operations. Select a previous save or restore operation to repeat the action.

Operation

The **Operation** radio buttons let you select between load operations and save operations.

Register List

The register list lets you select the register banks that you want to save. You may select more than one register bank. The register list is only available for save operations.

Filename

The **Filename** text field lets you specify the file you wish to use for the desired save or restore operation.

Overwrite Existing

The **Overwrite Existing** checkbox lets you specify that you wish to overwrite any existing files. This option is only available for save operations.

7

Multi-Core Debugging

Multi-core debugging lets you debug multiple cores connected on a JTAG chain. You create a separate project to run on each core, and debugging each core in its own debugger window.

You may debug multiple cores with either the MSC8102 simulator or real hardware.

This chapter contains the following topics:

Setting Up to Debug Multiple Targets

This section lists the general steps you follow to begin multi-chip debugging.

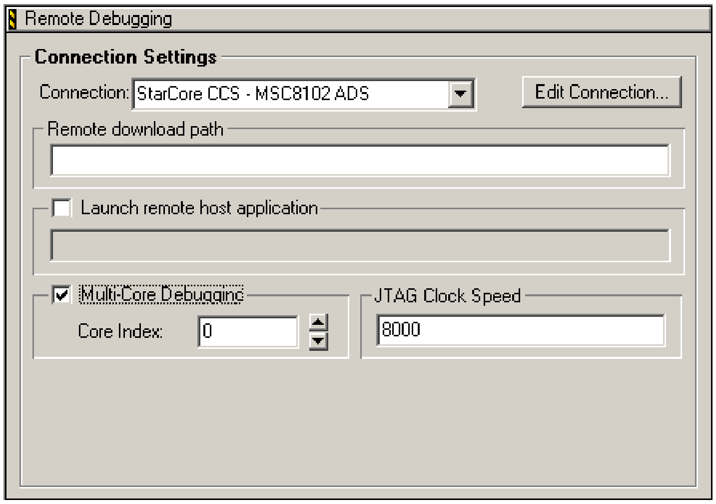
To set up for multi-chip debugging:

1. Set up and connect your JTAG chain of target boards.

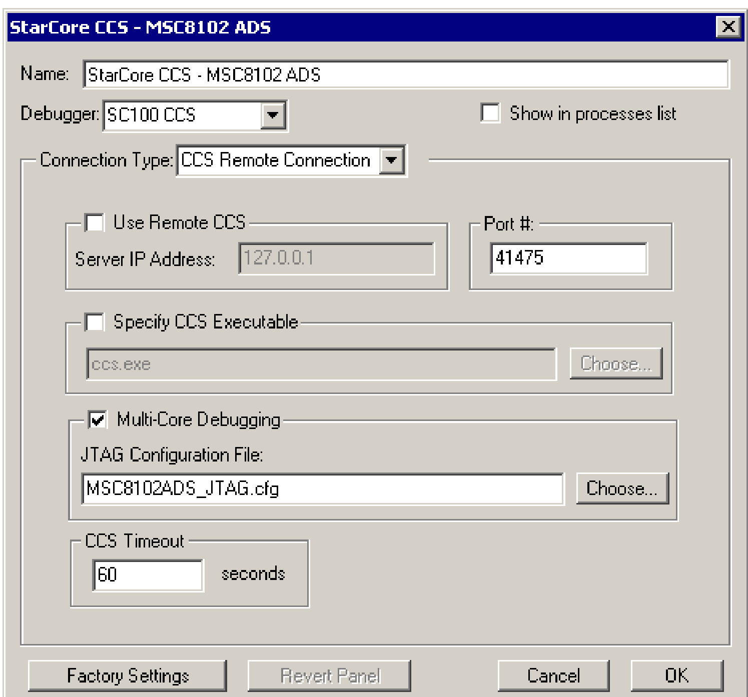
2. Create a JTAG initialization file that describes the items on the JTAG chain.

3. Open a project to debug. (If you are debugging more than one core, each core must have its own project.)

4 In the Remote Debugging target settings panel, enable the Multi-Core Debugging option and specify the core index.



5 Click the Edit Connection button to open the Remote Connection window.



6 Enable the Multi-Core Debugging option and specify the name of the JTAG initialization file.

NOTE Depending on the project you are debugging and the stationery you are using, you may need to change other target settings. This section discusses only target settings that are related to multi-chip debugging.

7 Select **Project > Run**.

The IDE downloads the program to the specified core. You can begin debugging.

JTAG Initialization File

To debug multiple cores in a JTAG chain, you must create a JTAG initialization file that specifies the type and the order of the cores that you intend to debug.

To specify StarCore chips that contain one core, you must specify `SC140` as the name of the chip you are debugging. For example, Listing 7.1 shows a JTAG initialization file for three StarCore chips in a JTAG chain.

Listing 7.1 Example JTAG Initialization File for StarCore Boards (Single-Core Chip)

```
# JTAG Initialization File

# Has an index value of 0 in the JTAG chain
SC140
# Has an index value of 1 in the JTAG chain
SC140
# Has an index value of 2 in the JTAG chain
SC140
```

You also can specify to debug multiple cores on one chip (for example, an MSC8102 chip). Listing 7.2 shows a JTAG initialization file that specifies multi-core debugging on an MSC8102 chip:

Listing 7.2 Example JTAG Initialization File for MSC8102 Chip

```
# JTAG Initialization File

# Indicates that multi-core debugging on a single chip
# (MSC8102) will be performed
```

```
MSC8102Sync
# Has an index value of 0 in the JTAG chain
MSC8102
# Has an index value of 1 in the JTAG chain
MSC8102
# Has an index value of 2 in the JTAG chain
MSC8102
# Has an index value of 3 in the JTAG chain
MSC8102
```

In addition, you can specify other chips to debug on the JTAG chain. To do so, you use the following syntax to specify the chip as a generic device:

`Generic` *instruct_reg_length data_reg_bypass_length JTAG_bypass_instruction*

Table 7.1 shows the definitions of the variables that you must specify for a generic device.

Table 7.1 Syntax Variables to Specify a Generic Device on a JTAG Chain

Variable	Description
instruct_reg_length	Length in bits of the JTAG instruction register.
data_reg_bypass_length	Length in bits of the JTAG bypass register.
JTAG_bypass_instruct	Hexadecimal value that specifies the JTAG bypass instruction.

Listing 7.3 shows a JTAG initialization file that includes a StarCore chip and a generic device in a JTAG chain.

Listing 7.3 Example JTAG Initialization File with a Generic Device

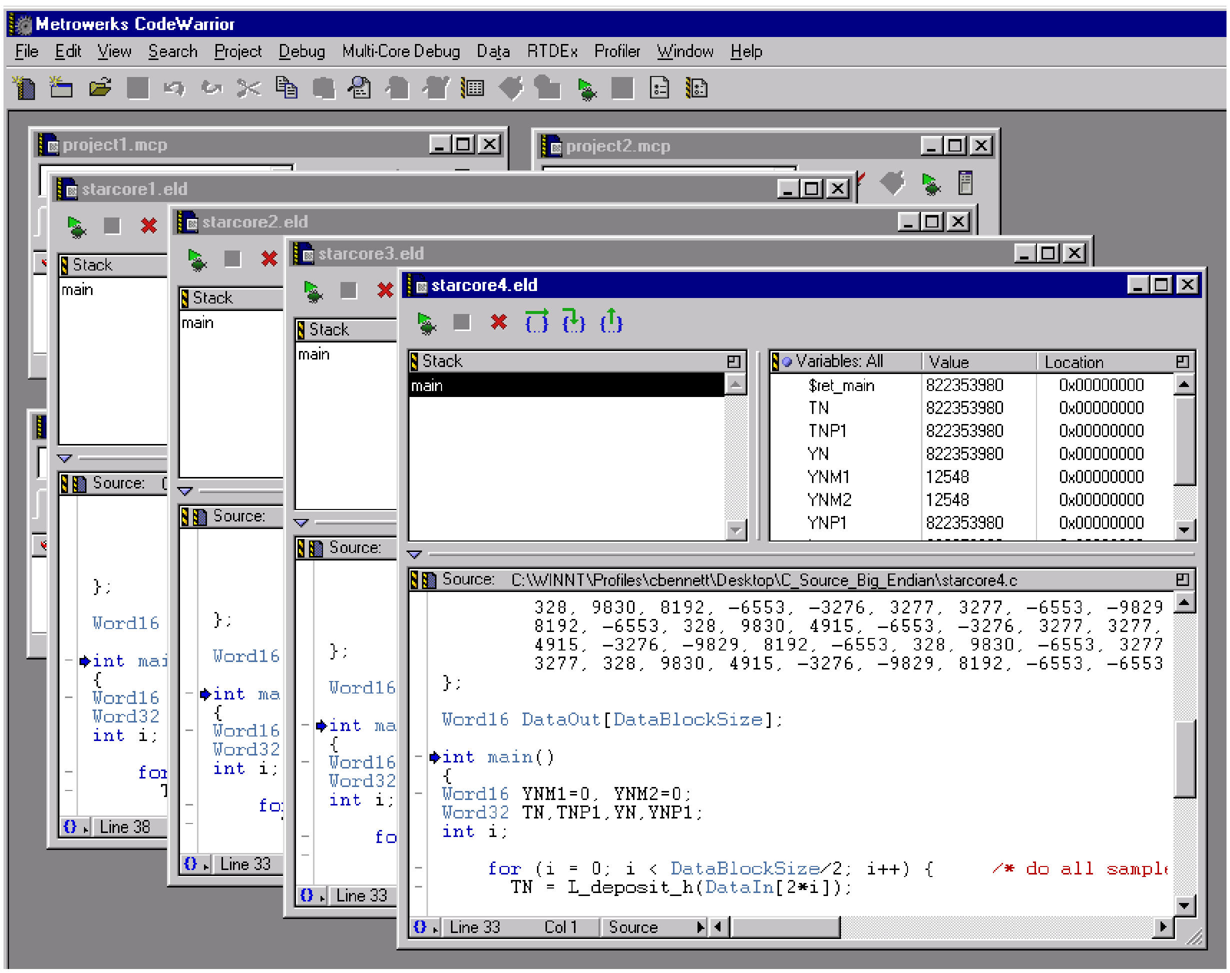
```
# JTAG Initialization File

# Has an index value of 0 in the JTAG chain
SC140
# Has an index value of 1 in the JTAG chain
Generic 4 1 Oxf
```

LDebugging with Multiple Cores

When you start to debug a multi-core project, the IDE downloads the related targets to the appropriate cores, with correct settings for multi-core debugging.

Figure 7.1 shows an initial download of a multi-core project created from a multi-core stationery (before any changes have been made to the projects by a developer). As the figure shows, the IDE creates a separate debugging window for each project in the multi-core project.

Figure 7.1 Initial Download of Multi-Core Project Created from Stationery



8 Use the simulator projects to create your own applications to debug, adding and deleting files and code to the various projects as needed

(just as you would do with any other project created from stationery).

NOTE You can kill all the debugging windows to remove them while you work with the project windows, if you choose. To do so, choose **Multi-Core Debug > Kill All**.

9 If needed, adjust any target settings related to your multi-core projects.

NOTE The target settings related to multi-core debugging should work correctly without adjustment.

10 When you are ready to debug, choose **Project > Debug** to download your multi-core projects to the simulator.

11 Debug using standard single-core debugging commands and multi-core debugging commands as needed.

Using Multi-Core Debugging Commands

When debugging a multi-core project, you can use multi-core debugging commands. (You also can use the standard single-core debugging commands to debug parts of each core project.)

You access the multi-core debugging commands using the Multi-Core Debug menu.

Table 7.2 describes the multi-core debugging commands.

Table 7.2 Multi-Core Debugging Commands

Select this command...	To perform this action...
Multi-Core Debug > Run All	A multi-core run. This command starts all cores executing as close to the same time as possible. (This action also is known as a synchronous run.)
Multi-Core Debug > Stop All	A multi-core stop. This command stops all cores executing as close to the same time as possible. (This action also is known as a synchronous stop.)
Multi-Core Debug > Kill All	Kill all multi-core debugging sessions as close to the same time as possible.

Synchronized Stop

When you perform multi-core debugging using the MSC8102 simulator, you can use an additional feature called synchronized stop.

Synchronized stop means that when any of the executing cores stops (for example, because the core encounters a software breakpoint or you issue an explicit stop command), all the other currently executing cores stop, too.

Before you can use the synchronized stop feature, you must enable it. (Enabling this feature sets bit 10 and bit 15 of the ESEL_DM register. Disabling this feature clears those bits.)

To enable synchronized stop, perform these steps after starting to debug a multi-core project:

1. Choose **SC100 > MSC8102 Sim/ADS > MSC8102 Sync Stop**.

   The MSC8102 Synchronized Stop dialog box appears (Figure 7.2).

Figure 7.2 MSC8102 Synchronized Stop Dialog Box

2 Select the **Check to enable** checkbox.

3 Click OK.

8

iCache Performance Analysis

This chapter describes CodeWarrior features as they relate to code profiling and performance analysis.

This chapter contains the following topics:

- iCacheViewer Window
- iCache Performance Tool

iCacheViewer Window

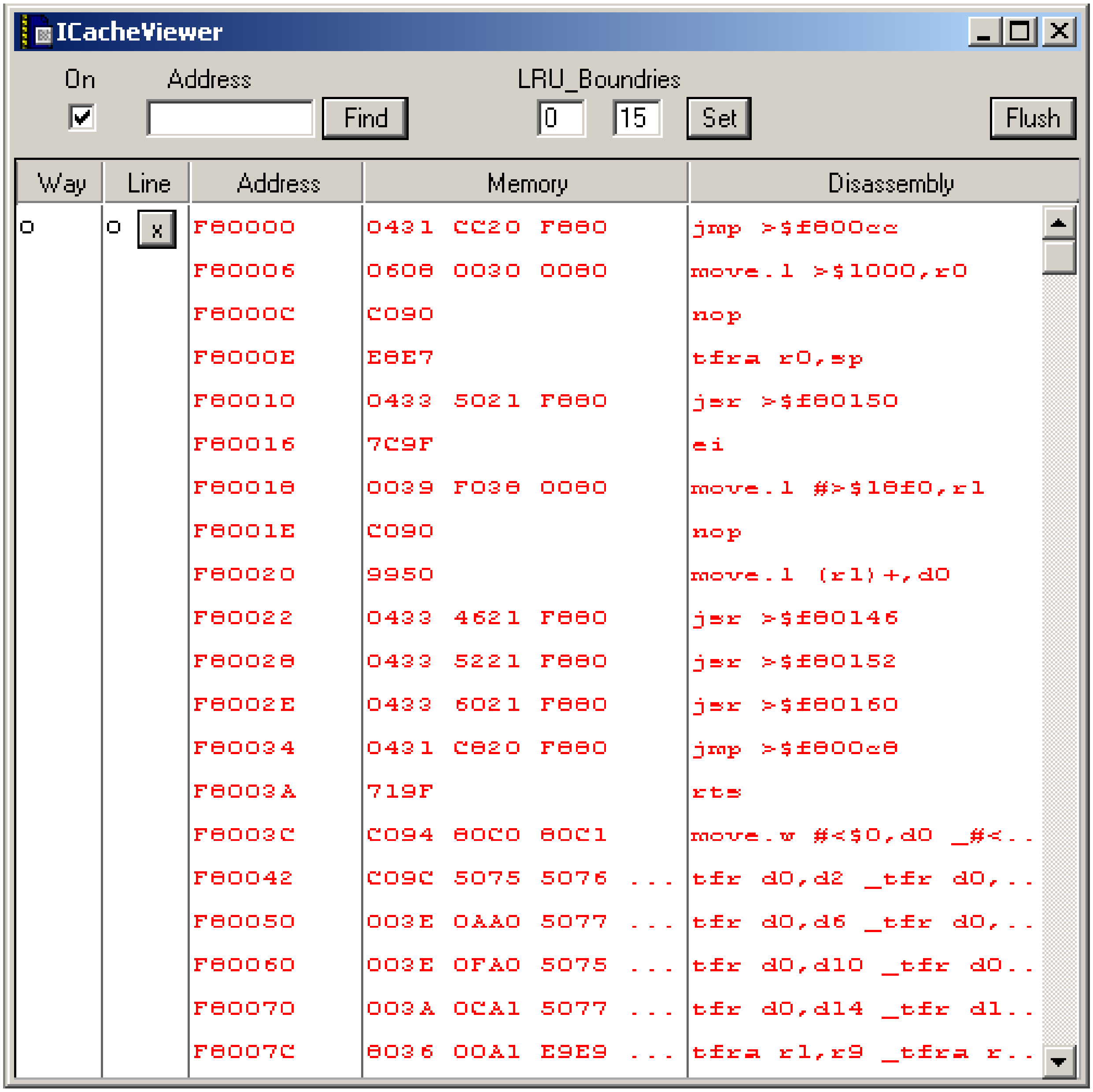
After you begin debugging a project for an SC140e processor, you can view the contents of the instruction cache while debugging.

NOTE The iCache Viewer window applies only when debugging using the MSC8102 simulator.

To view the contents of the iCache, choose **View > iCache Viewer.**

The IDE displays an iCache Viewer window (Figure 8.1).

Figure 8.1 iCache Viewer Window



In the iCache Viewer window, valid information that changed displays as red text. Invalid information displays as gray text and the rest as black text.

You can perform several actions in the iCache Viewer window. Table 8.1 lists and describes these actions.

Table 8.1 iCache Viewer Window Actions

Action	Description
Find an address	Type a hexadecimal address in the Address field and click find. The view jumps to the line containing the address if it resides in the ICache.
Set the LRU boundaries	Type the lower and upper boundary values (0-15) and click Set.
Flush the entire ICache	Click the Flush button. (The Flush button causes the valid bits array to be filled with zeroes.) All data appears as gray text.
Flush one line of the iCache	Press the x button in the line column when viewing the specific line you want to flush.

iCache Performance Tool

You can use the iCache Performance tool to examine information related to the instruction cache.

NOTE The iCache Performance tool applies only when you debug using the MSC8102 simulator.

Input Files for the iCache Performance Tool

The iCache Performance tool uses these types of files to display data about the instruction cache for a particular core:

- An executable file
- An instruction cache trace buffer file (dump file)

You can load data from an instruction cache trace buffer file that contains data for one core or from an instruction cache trace buffer file that contains data for four cores.

To generate an appropriate executable file to use with the iCache Performance tool, change your linker command file so that the linker places instructions into cacheable memory.

In the MSC8102 simulator, generate an instruction cache trace buffer file (dump file) by entering commands similar to those in Listing 8.1:

Listing 8.1 Simulator Commands to Generate an Instruction Cache Trace Buffer File

```
device dv0 msc8102
load starcore.eld
log eqbs starcore.dmp
trace 30 cy
```

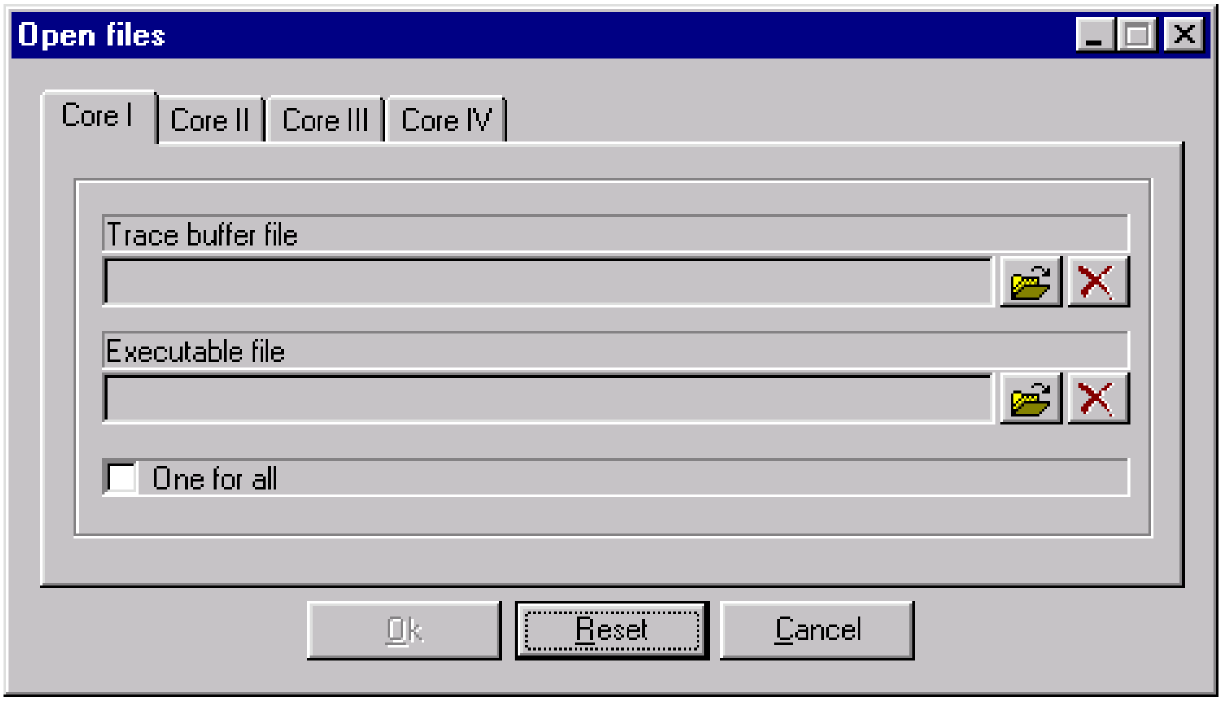
After you enter the appropriate simulator commands for your program, the simulator generates an instruction cache trace buffer file. You then can quit the simulator.

Starting the iCache Performance Tool

To start the iCache Performance tool, choose **View > iCache Performance**.

The IDE displays the Open Files window (Figure 8.2).

Figure 8.2 Open Files Window



You can load data from an instruction cache trace buffer file that contains data for one core or from an instruction cache trace buffer files that contains data for four cores.

Loading Data for Cores from Separate Files

To load data from separate instruction cache trace buffer files for each core you examine, perform these steps in the Open Files window:

1. Specify a separate trace buffer file and executable file on each tab of the Open Files window.

NOTE The Open File icon opens a standard dialog box that you can use to navigate to a file. The X icon clears the field.

2. Click O.K.

   The Open Information window appears.

3 Click O.K.

A window appears that contains the All Cores view.

Loading Data for Cores from One File

To load data from an instruction cache trace buffer file that contains data for four cores, perform these steps in the Open Files window:

1 Select the **One for all** checkbox.

The four core tabs consolidate into an All Cores tab.

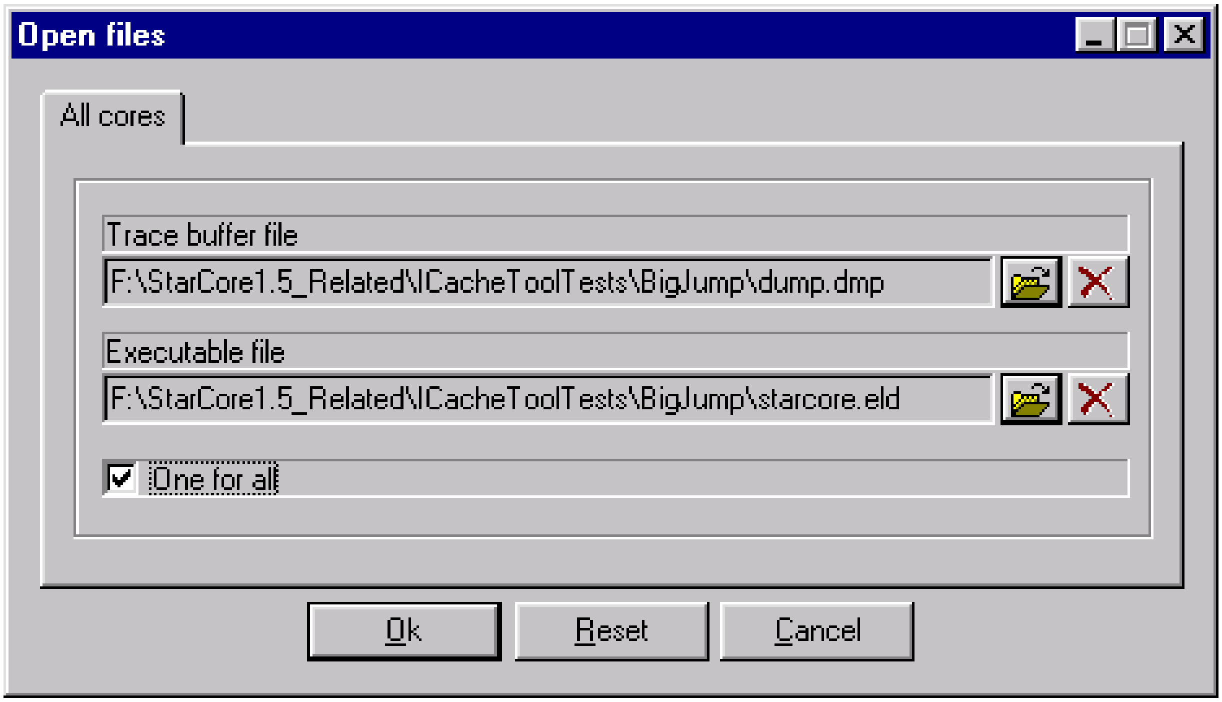
2 Specify the name of the four-core instruction cache trace buffer file.

NOTE The Open File icon opens a standard dialog box that you can use to navigate to a file. The X icon clears the field.

3 Specify the name of the executable file.

Figure 8.3 shows how the Open Files window might look after you perform the preceding steps.

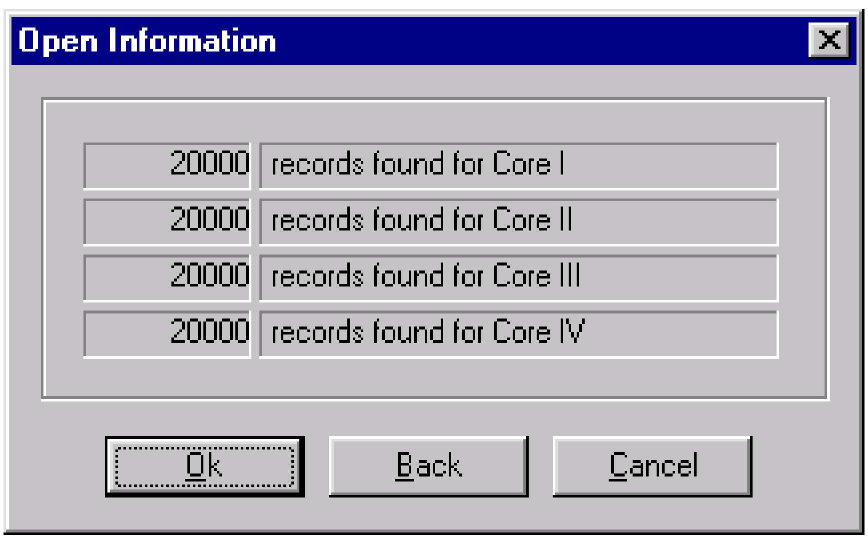
Figure 8.3 Open Files Window with One for all Checkbox Selected



4 Click O.K.

The Open Information window appears (Figure 8.4).

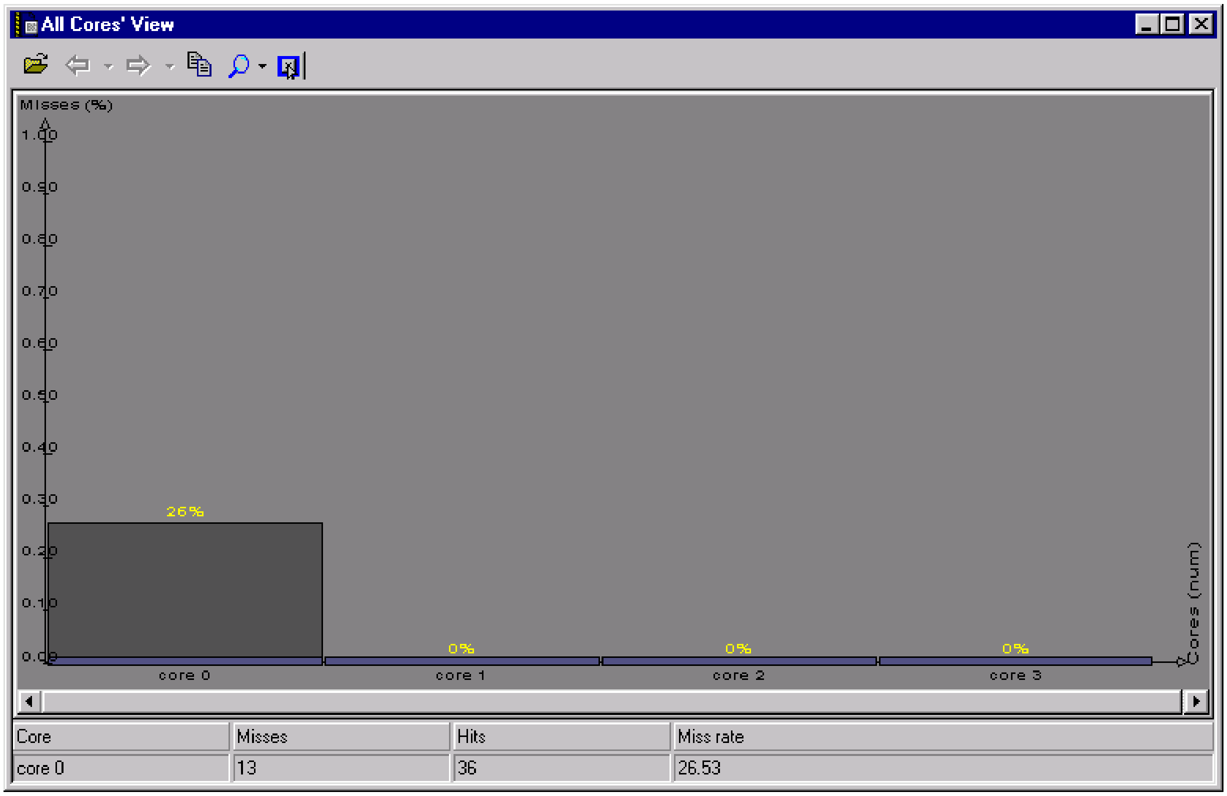
Figure 8.4 Open Information Window



5 Click O.K.

A window appears that contains the All Cores view (Figure 8.5).

Figure 8.5 All Cores View



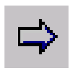
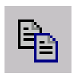
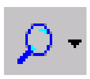
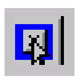
At this point, you can begin examining the instruction cache data, which you can examine using several views.

iCache Performance Menu and iCache Toolbar

After you start the iCache Performance Tool and load core data into the tool, the iCache Performance menu appears in the IDE and the All Cores view appears. The window in which the various icache views appear has several buttons on its toolbar; almost all of them correspond to a menu item in the iCache Performance menu.

Table 8.2 lists and describes the commands in the iCache Performance menu and the buttons in the iCache toolbar.

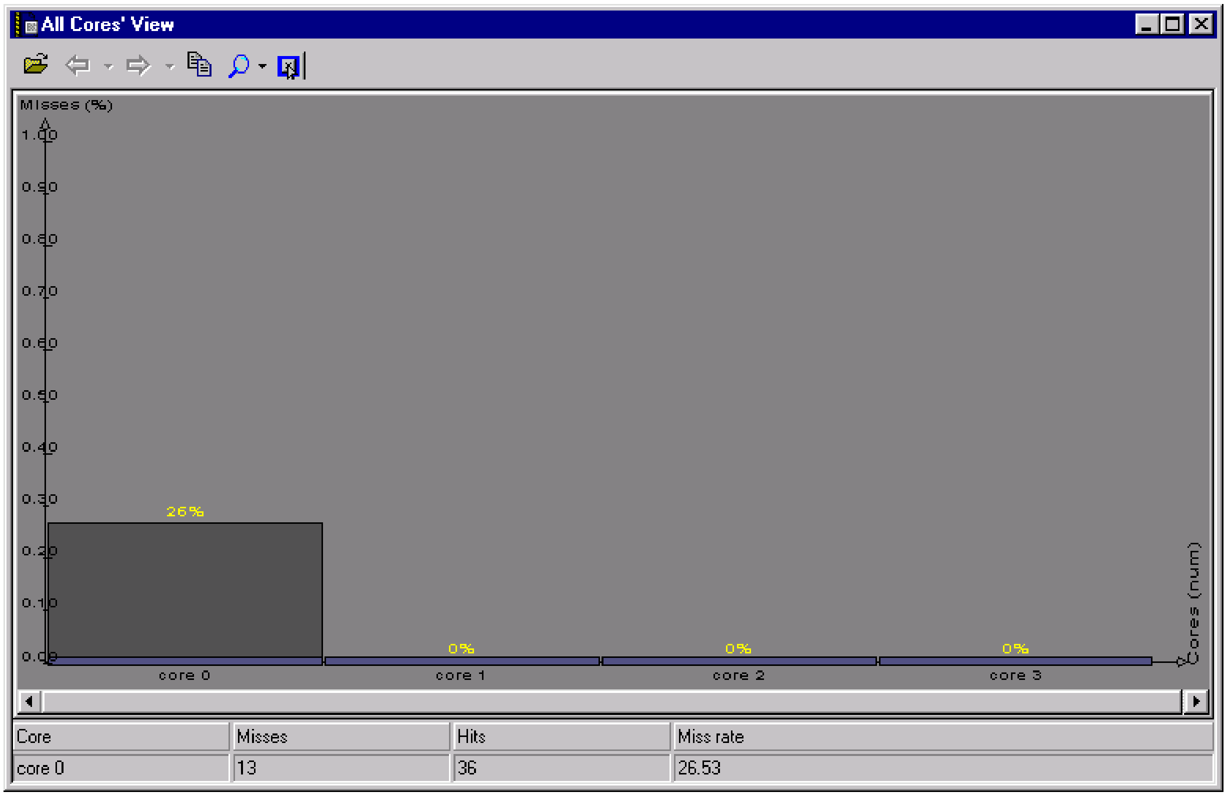
Table 8.2 iCache Performance Menu Commands and iCache Toolbar Buttons

Command	Button	Description
Open		Displays the Open Files window, where you can specify a new set of files to work with.
Go Back		The IDE maintains the views you examine after opening the All Cores view in a list. Go Back displays the previous view that you examined before the currently displayed view.
Go Forward		The IDE maintains the views you examine after opening the All Cores view in a list. Go Forward displays the next view forward from the currently displayed view.
Clone Window		Displays another copy of the currently selected iCache view window (regardless of which view is currently displayed in the window).
		Magnitude (button only). Changes the magnitude (height of bars) of the view.
Close Graph		Closes the currently selected iCache view window (regardless of which view is currently displayed in the window).

All Cores View

The All Cores view (Figure 8.6) presents information about all four cores (one column for each core).

Figure 8.6 All Cores View



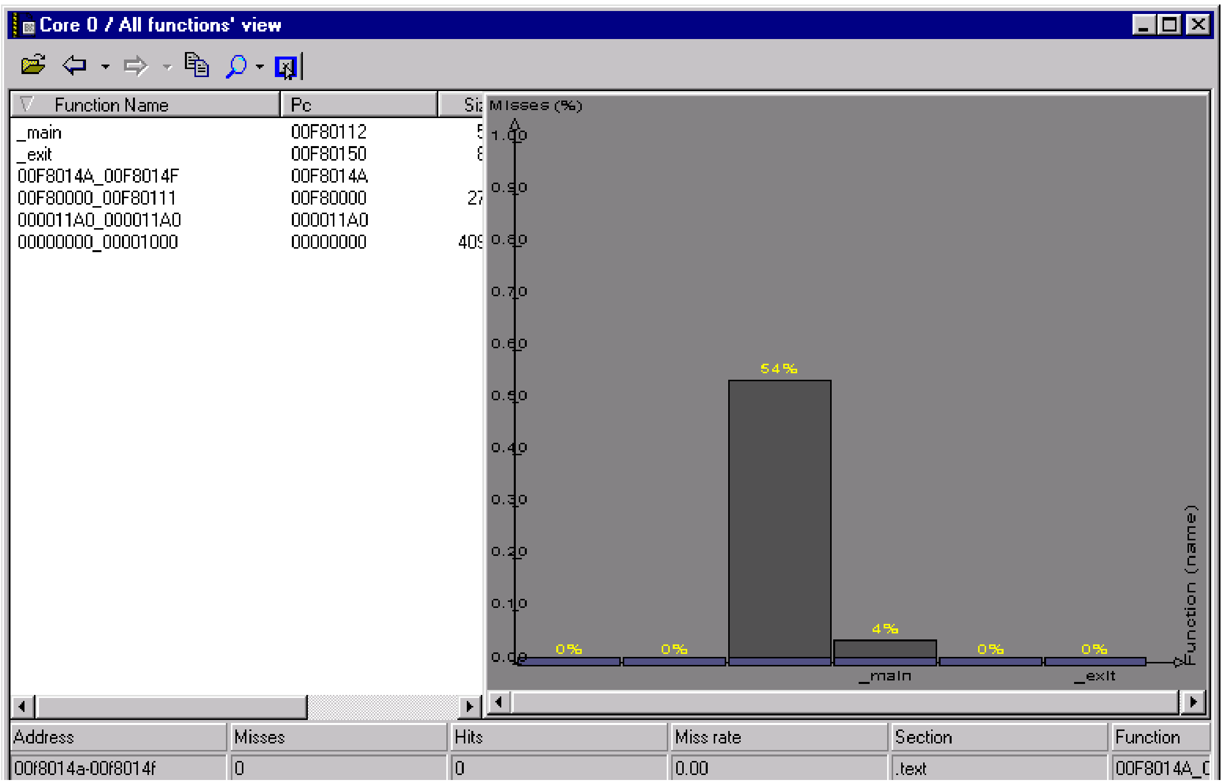
The bottom panel of the All Cores view displays useful information when a mouse passes over different parts of the view.

Double-clicking on a bar displays the next view (Core).

Core View

The Core view ([Figure 8.7]) presents information about executable code on the specified core (one bar per function). The function can be a regular function or just executable code that is not declared as a function.

Figure 8.7 Core View



The left side of the Core view lists all functions and these corresponding values for each function:

- PC (program counter)
- Size
- Hits
- Misses
- Miss rate (shown as a percentage)

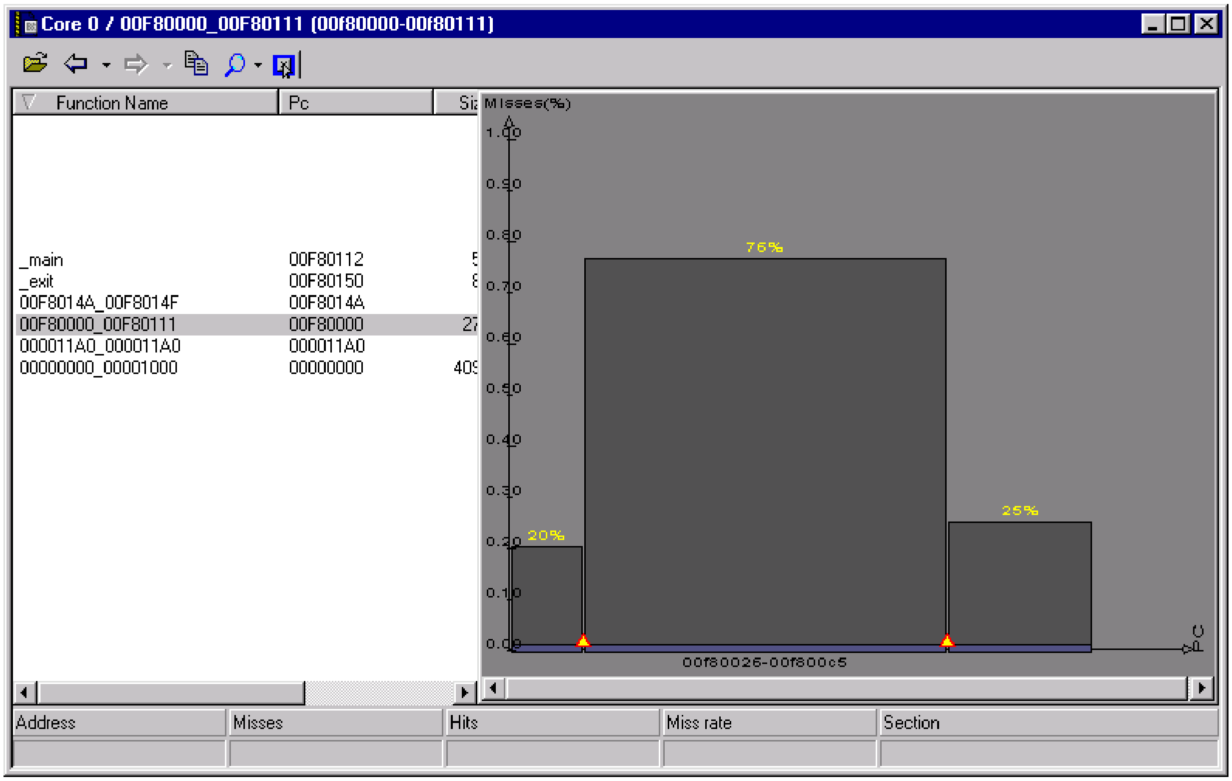
The bottom panel of the Cores view displays useful information when a mouse passes over different parts of the view.

Double-clicking on a bar displays the next view (Function).

Function View

The Function view (Figure 8.8) presents information for a single function. The view displays one bar for each interval, where an interval represents contiguous code between calls to other functions.

Figure 8.8 Function View



The triangles represent function calls. Double-clicking on a triangle (or above a triangle) displays the Function view of the called function.

The left side of the Function view lists all functions and these corresponding values for each function:

- PC (program counter)
- Size
- Hits
- Misses
- Miss rate (shown as a percentage)

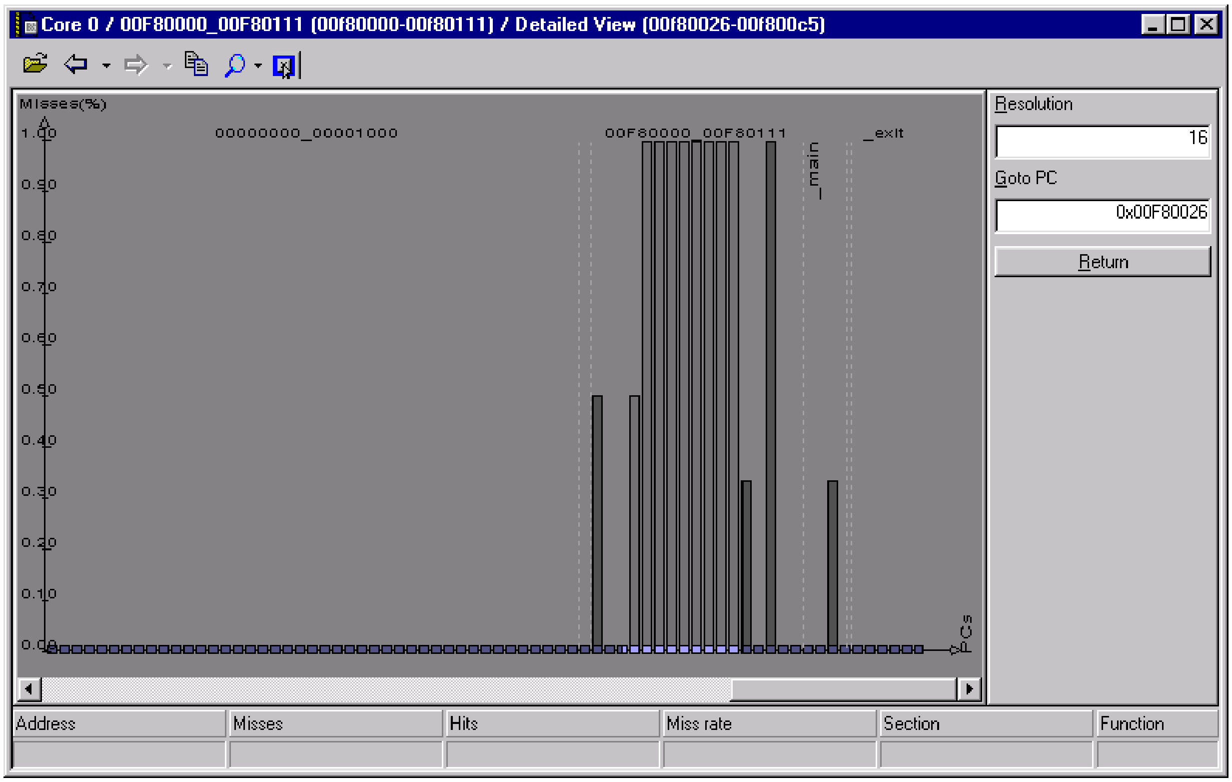
The bottom panel of the Function view displays useful information when a mouse passes over different parts of the view.

Double-clicking on a bar displays the next view (PC).

PC View

The PC view (Figure 8.9) displays all executable code with the specified resolution.

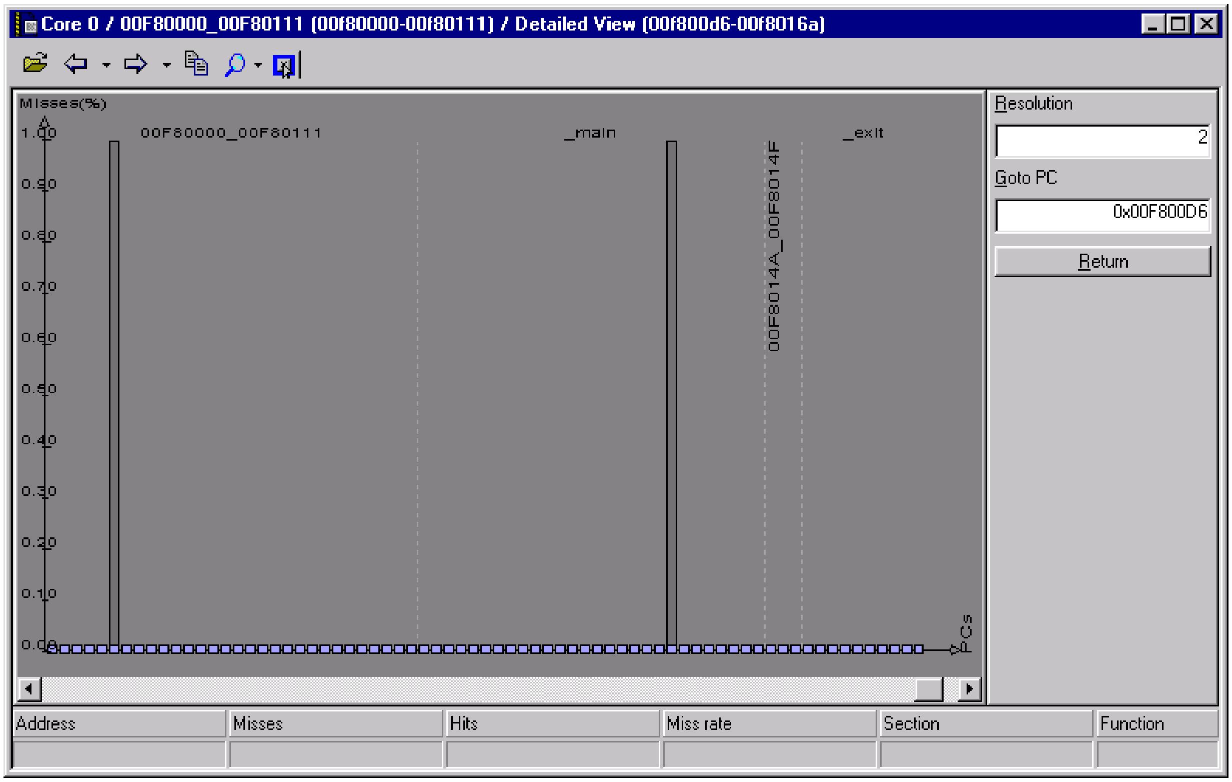
Figure 8.9 PC View



You can specify a different resolution in the Resolution text field and a different PC in the Goto PC text field. (You can easily return to the starting position by clicking Return.)

You can select some interval on the graph by pressing the left mouse button, dragging over the chosen area, and releasing the left mouse button. After you release the left mouse button, the IDE displays a new graph created with the selected area expanded (Figure 8.10).

Figure 8.10 New PC View After Selecting an Interval



Double-clicking on a bar in a PC View displays the Function view of the function whose PC you clicked.

9

Enhanced On-Chip Emulation (EOnCE)

This chapter describes the EOnCE module, a separate on-chip block that allows non-intrusive interaction with the core. You can use the EOnCE module to examine the contents of registers, memory, or on-chip peripherals in a special debugging environment.

This chapter contains these topics:

EOnCE Features

With the EOnCE module, you can keep a running trace of tasks, interrupts, and when each occurred.

EOnCE Features Overview

EOnCE provides the following advantages:

- Reduces system intrusion when debugging
- Reduces the use of general-purpose peripherals for debugging input and output
- Standardizes system-level debugging across multiple platforms
- Includes a rich set of breakpoint features

  One of the main differences between setting regular software breakpoints and setting breakpoints using EOnCE is that, when you set a regular software breakpoint, the program stops executing immediately *before* the instruction on which you set the breakpoint. When you set a breakpoint using

EOnCE, the program stops executing immediately *after* the instruction.

- Provides the ability to non-intrusively read from and write to peripheral registers while debugging
- Provides a trace buffer for program flow and data tracing
- Uses a programming model that is accessible either directly by your software or by the CodeWarrior debugger
- Does not require that peripherals be halted during debug mode

EOnCE Trace Buffer Overview

The following information is pertinent when using the EOnCE trace buffer:

- The trace buffer is a circular buffer. When the buffer is full, if you continue to step through code, the buffer is overwritten from the beginning.
- You can determine whether the trace buffer is full by examining the TBFULL bit of the ESR (EOnCE Status Register) register. When the trace buffer is full, the TBFULL bit is set.
- You can trace up to 2048 bytes worth of addresses in the trace buffer.
- You must enable the trace buffer each time before getting new trace information.

EOnCE Configurator Panels Description

This section provides a description of the EOnCE Configurator panels that you use to set up debugging with EOnCE.

NOTE When selecting settings in the EOnCE Configurator, configure the tabbed panels in the left-to-right order of the tabs. For example, configure the Address Event Detection Channel 0 panel before configuring the Event Counter panel. In addition, configure your selected settings from the left-top position to the right-bottom position within a panel.

You can save settings that you specify in the EOnCE Configurator for your current debugging session only by clicking OK in the EOnCE Configurator window.

You can save an EOnCE configuration in a file for later reuse by choosing **Debug > EOnCE > Save EOnCE Configuration** and specifying the file name to save to.

You can open a previously saved EOnCE configuration file to use with a project by choosing **Debug > EOnCE > Open EOnCE Configuration** and navigating to the location of the EOnCE configuration file.

- EE Pins Controller panel
- Address event detection channel panels
- Data Event Detection Channel panel
- Event Counter panel
- Event Selector panel
- Trace Unit panel

EE Pins Controller panel

Figure 9.1 displays the EE Pins Controller panel, which you can use to configure the EOnCE controller, specifically the EE pins. EE pins are general-purpose pins that can serve as input or output pins to the EOnCE.

Figure 9.1 EE Pins Controller Panel

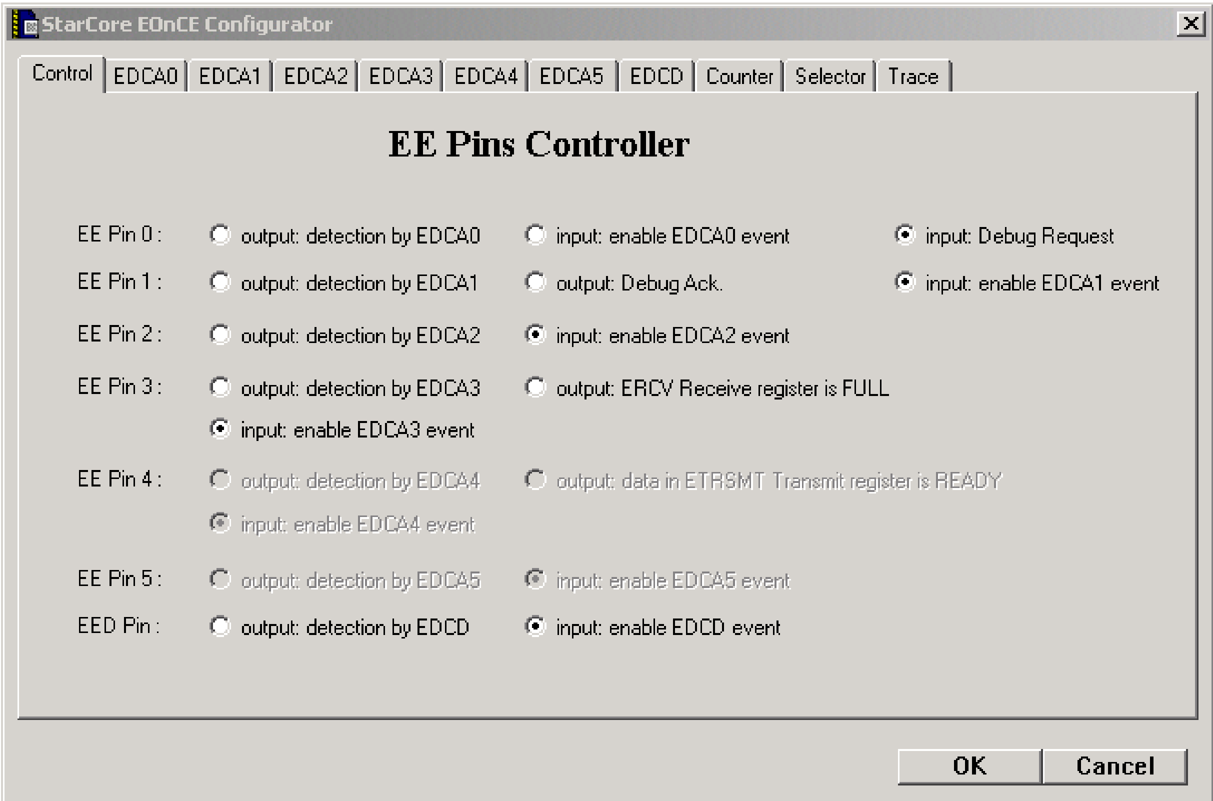


Table 9.1 describes the items that you can specify on the EE Pins Controller panel in the EOnCE Configurator.

Table 9.1 EE Pins Controller Panel Description

Panel Item	Description	
EE Pin 0	Three possible settings exist:	
	Setting	**Description**
	output: detection by EDCA0	After an event is detected on EDCA0 (event detection channel 0), the signal on EE pin 0 is toggled.
	input: enable EDCA0 event	An input signal from EE pin 0 enables an event on EDCA0 (event detection channel 0).
	input: Debug Request	A signal asserted to EE pin 0 during and after reset causes the core to enter debug mode. A signal asserted to EE pin 0 also causes an exit from stop or wait processing states of the core.

Table 9.1 EE Pins Controller Panel Description (*continued*)

Panel Item	Description
EE Pin 1	Three possible settings exist: **Setting** — **Description** output: detection by EDCA1 — After an event is detected on EDCA1 (event detection channel 1), the signal on EE pin 1 is toggled. output: Debug Ack. — A signal is asserted to EE pin 1 after the core enters debug mode. A signal is negated to EE pin 1 after the core exits from debug mode. input: enable EDCA1 event — An input signal from EE pin 1 enables an event on EDCA1 (event detection channel 1).
EE Pin 2	Two possible settings exist: **Setting** — **Description** output: detection by EDCA2 — After an event is detected on EDCA2 (event detection channel 2), the signal on EE pin 2 is toggled. input: enable EDCA2 event — An input signal from EE pin 2 enables an event on EDCA2 (event detection channel 2) and ECNT.
EE Pin 3	Three possible settings exist: **Setting** — **Description** output: detection by EDCA3 — After an event is detected on EDCA3 (event detection channel 3), the signal on EE pin 3 is toggled. output: ERCV Receive register is full — A signal is asserted to EE pin 3 after the host finishes writing to the ERCV register. A signal is negated to EE pin 3 after the host finishes reading the ETRSMT register. input: enable EDCA3 event — An input signal from EE pin 3 enables an event on EDCA3 (event detection channel 3).
EE Pin 5	Not applicable.
EE Pin 5	Not applicable.

Table 9.1 EE Pins Controller Panel Description (*continued*)

<table>
<tr><th>Panel Item</th><th colspan="2">Description</th></tr>
<tr><td rowspan="4">EED Pin</td><td colspan="2">Two possible settings exist:</td></tr>
<tr><th>Setting</th><th>Description</th></tr>
<tr><td>output: detection by EDCD</td><td>After an event is detected on the EDCD (Data Event Detection channel), the signal on the EED pin is toggled.</td></tr>
<tr><td>input: enable EDCD event</td><td>An input signal from the EED pin enables an event on EDCD (the Data Event Detection channel).</td></tr>
</table>

Address event detection channel panels

The EOnCE module includes several address event detection channels that can detect address values from an address bus according to the selections you choose. Each address event detection channel has a corresponding EOnCE Configurator panel:

- Address Event Detection Channel 0 (EDCA0)
- Address Event Detection Channel 1 (EDCA1)
- Address Event Detection Channel 2 (EDCA2)
- Address Event Detection Channel 3 (EDCA3)
- Address Event Detection Channel 4 (EDCA4)
- Address Event Detection Channel 5 (EDCA5)

NOTE The CodeWarrior IDE uses EDCA5 in conjunction with hardware watchpoints. Consequently, the Address Event Detection Channel 5 panel is disabled in the EOnCE Configurator.

Figure 9.2 shows an example of a EOnCE Configurator panel for an address event detection channel.

Figure 9.2 Address Event Detection Channel 0 Panel

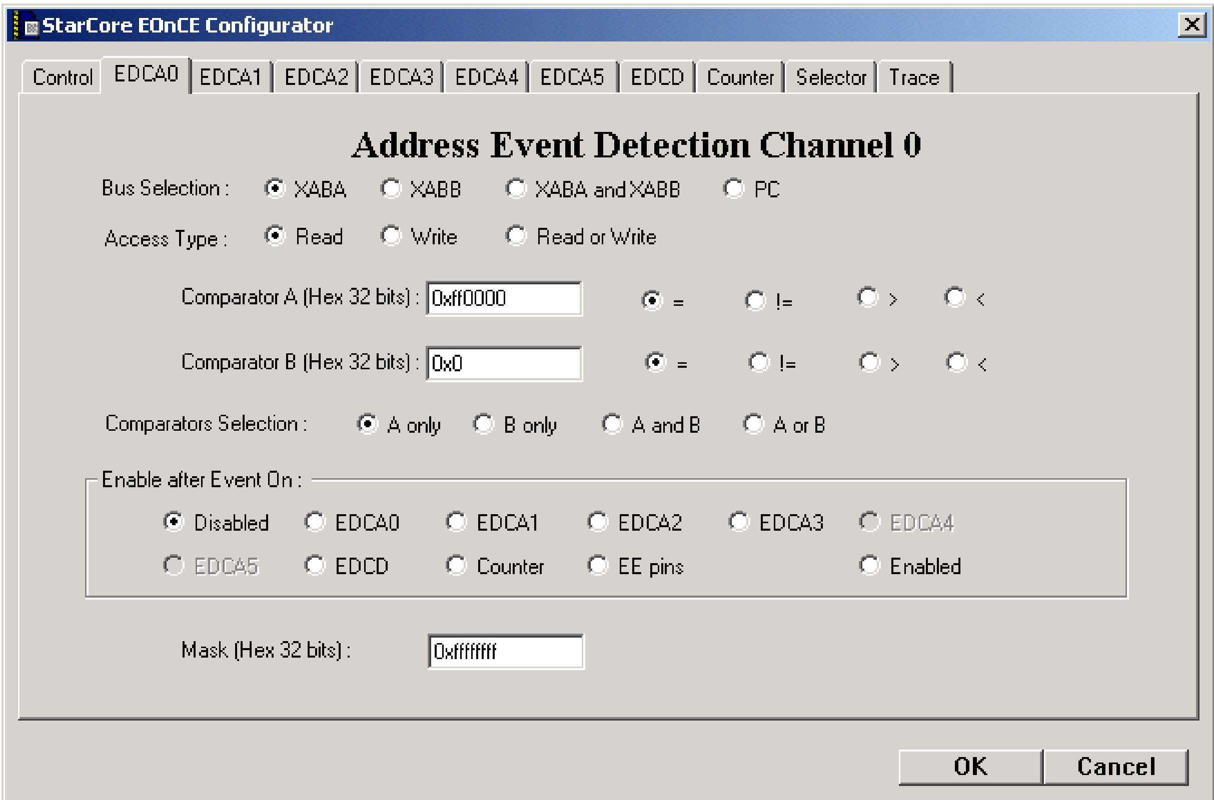


Table 9.2 describes the items that you can specify on address channel panels in the EOnCE Configurator.

Table 9.2 Address Channel Panel Description

Panel Item	Description
Bus Selection	The bus on which to detect an address value. You can specify: • XABA • XABB • XABA and XABB • PC For example, to set a breakpoint on an instruction, specify PC, which indicates the value of the program counter.
Access Type	The type of access performed on the specified address. You can specify: • Read • Write • Read or write
Comparator A	Specify a hexadecimal value (with a maximum length of 32 bits) with which to compare the detected address value. You can specify the following types of comparisons: • = (equal) • != (not equal) • > (greater than) • < (less than)
Comparator B	Specify a hexadecimal value (with a maximum length of 32 bits) with which to compare the detected address value. You can specify the following types of comparisons: • = (equal) • != (not equal) • > (greater than) • < (less than)
Comparators Selection	Choose a value or values with which to compare the detected address value. You can specify one of the following: • A only • B only • A and B • A or B

Table 9.2 Address Channel Panel Description (*continued*)

Panel Item	Description
Enable after Event On	Enable the comparison specified by this panel after an event on the specified item. You can specify one of the following: • Disabled • EDCA0, EDCA1, EDCA2, EDCA3 • EDCD • Counter • EE pins • Enabled If you select disabled, the IDE does not perform a comparison on the address. If you select enabled, the IDE performs the specified comparison if an event occurs on any of the items in the list.
Mask (Hex 32 bits)	Use this field to set the value of the EDCA mask register. The EDCA mask register allows masking of any of the bits in the detected address before the address is compared with a value that you specified in the Comparator A or Comparator B fields. (All the bits of this register are set to 1 during core reset.) The CodeWarrior IDE performs an AND operation on the bits of the detected address and the mask value, which has the following results: • An address bit that corresponds to a mask bit with a value of 1 keeps its original value (0 or 1) before being compared. • An address bit with a value of 0 that corresponds to a mask bit with a value of 0 keeps its original value before being compared. • An address bit with a value of 1 that corresponds to a mask bit with a value of 0 changes to a value of 0 before being compared. After applying the mask to the address, the CodeWarrior IDE performs any comparisons that you previously defined.

Data Event Detection Channel panel

You can use the Data Event Detection Channel panel to detect a particular data value.

Figure 9.3 shows the Data Event Detection Channel panel.

Figure 9.3 Data Event Detection Channel Panel

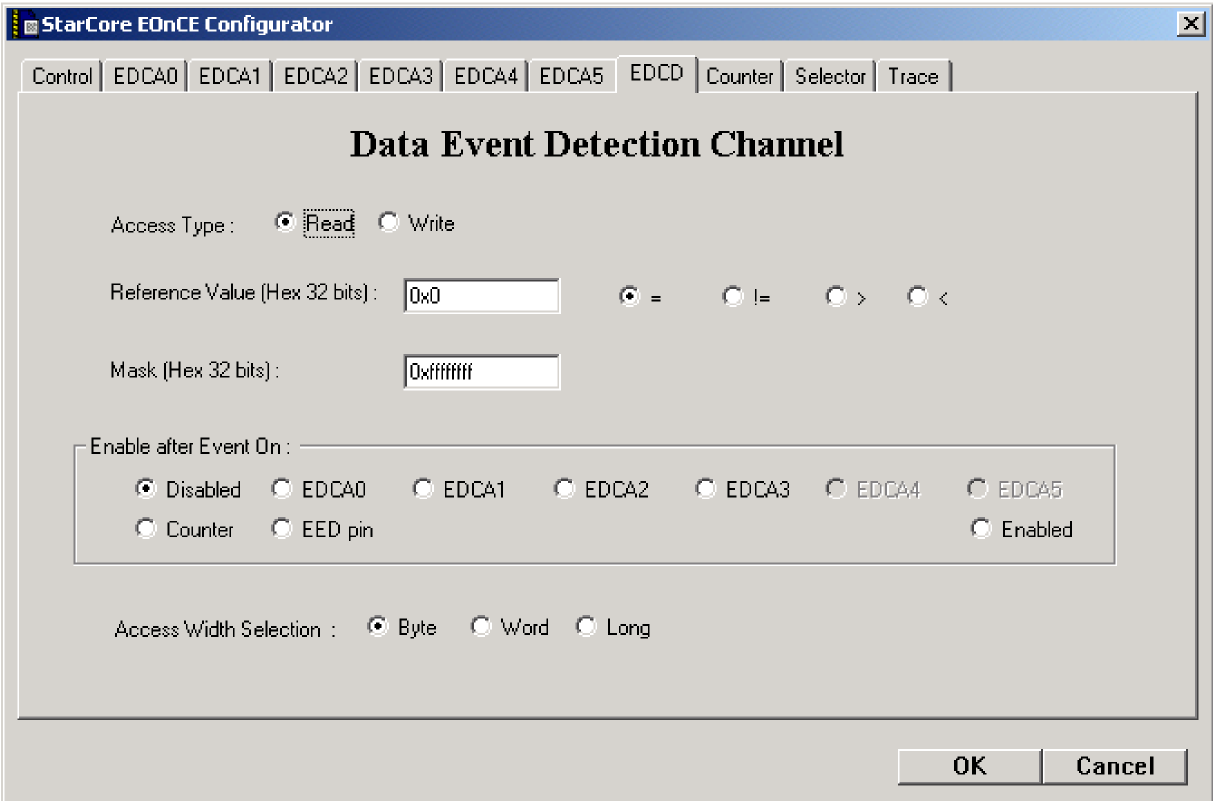


Table 9.3 describes the items that you can specify on the Data Event Detection Channel panel.

Table 9.3 Data Event Detection Channel Panel Description

Panel Item	Description
Access Type	Indicates whether the data value to detect is being read or written.
Reference Value	Specify a hexadecimal value (with a maximum length of 32 bits) with which to compare the detected address value. If you are specifying a byte or a word, use least-significant-bit (LSB) alignment. You can specify the following types of comparisons: • = (equal) • != (not equal) • > (greater than) • < (less than)
Mask	A 32-bit value that you can use to mask any bits in the sampled data value before the CodeWarrior IDE compares it to the specified reference value. Bits with a value of 0 in the mask cause the corresponding bit in the sampled data value to be set to 0. (A bitwise AND operation is performed on the mask value and sampled data value.) All the mask bits are set to 1 during reset.
Enable After Event On	Enable the comparison specified by this panel after an event on the specified item. You can specify one of the following: • Disabled • EDCA0, EDCA1, EDCA2, EDCA3 • Counter • EED pins • Enabled If you select disabled, the IDE does not perform a comparison on the sampled data value. If you select enabled, the IDE performs the specified comparison if an event occurs on any of the items in the list.

Table 9.3 Data Event Detection Channel Panel Description (*continued*)

Panel Item	Description
Access Width Selection	Indicates the width of the data access to watch. The CodeWarrior IDE compares the masked data and the reference value as follows, based on whether you specify byte, word, or long: • If you specify *byte*, the CodeWarrior IDE compares only the 8 least-significant bits of each value. • If you specify *word*, the CodeWarrior IDE compares only the 16 least-significant bits of each value. • If you specify *long*, the CodeWarrior IDE compares all 32 bits of each value.

Event Counter panel

EOnCE has a 64-bit event counter that can count events related to the following items:

- The address event detection channels
- The data event detection channel
- DEBUGEV instructions
- Trace buffer tracing
- Instruction execution
- The core clock

Figure 9.4 shows the Event Counter panel.

Figure 9.4 Event Counter Panel

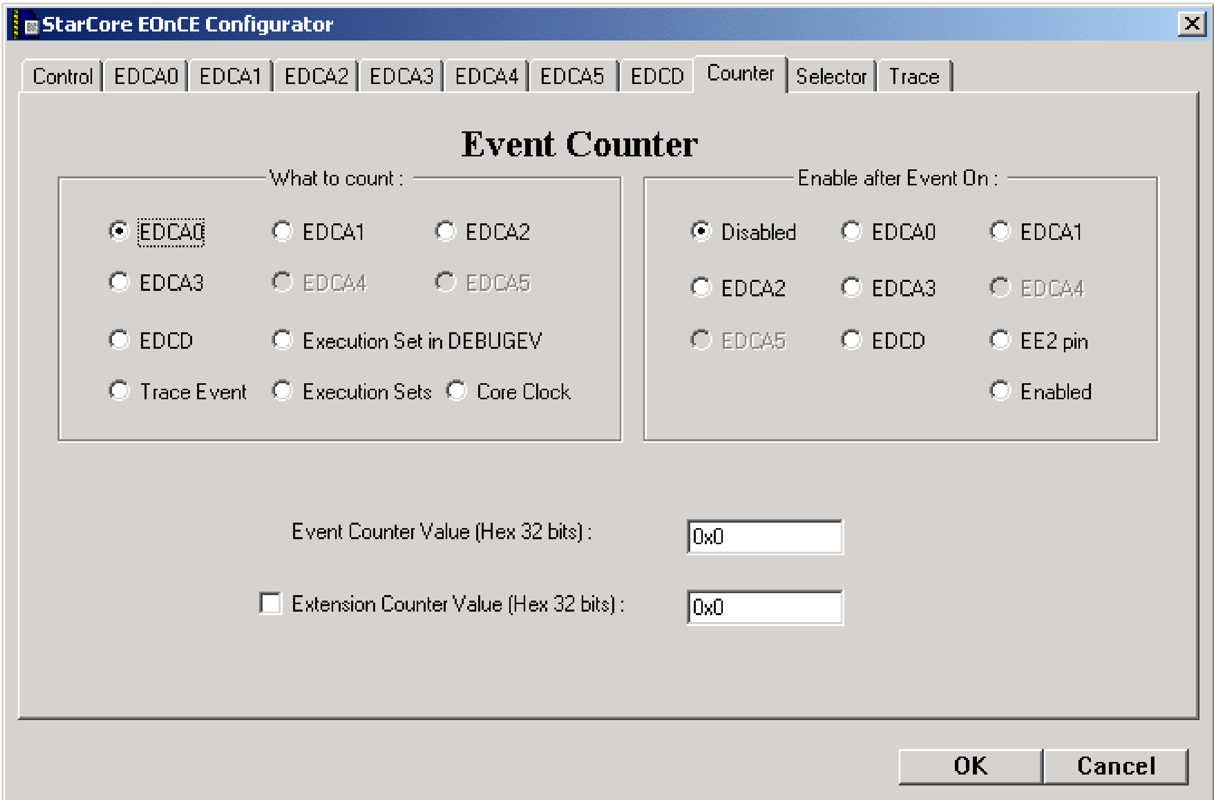


Table 9.4 describes the items that you can specify on the Event Counter panel in the EOnCE Configurator.

Table 9.4 Event Counter Panel Description

Panel Item	Description
What to count	Tell the CodeWarrior IDE to count events on the following items: • EDCA0, EDCA1, EDCA2, EDCA3 • EDCD • Execution Set in DEBUGEV • Trace Event • Execution Sets • Core Clock
Enable after Event On	Enable a count on an event for the item specified in the **What to count** group after an event on the specified item. You can specify one of the following: • Disabled • EDCA0, EDCA1, EDCA2, EDCA3 • EDCD • EE2 pin • Enabled If you select Disabled, the IDE does not perform a count. If you select Enabled, the IDE performs the count after an event occurs on any of the items in the list.
Event Counter Value	Specify the first 32 bits of the counter value (the maximum value to which to count).
Extension Counter Value	Specify the second 32 bits of the counter value (the maximum value to which to count). To use a 64-bit counter value, you must enable the checkbox next to this field.

Event Selector panel

The Event Selector panel specifies which events cause a particular debugging action to occur. The debugging actions follow:

- Place the EOnCE module in debug mode
- Generate a debugging exception
- Enable the trace buffer
- Disable the trace buffer

On the Event Selector panel, you can specify that after an event occurs on one of the following items, the corresponding debugging action occurs:

- Address event detection channels
- Data event detection channels
- Event counter
- EE pins
- DEBUGEV instructions

You also can specify that multiple events must occur to trigger a particular debugging event.

Figure 9.5 shows the Event Selector panel.

Figure 9.5 Event Selector Panel

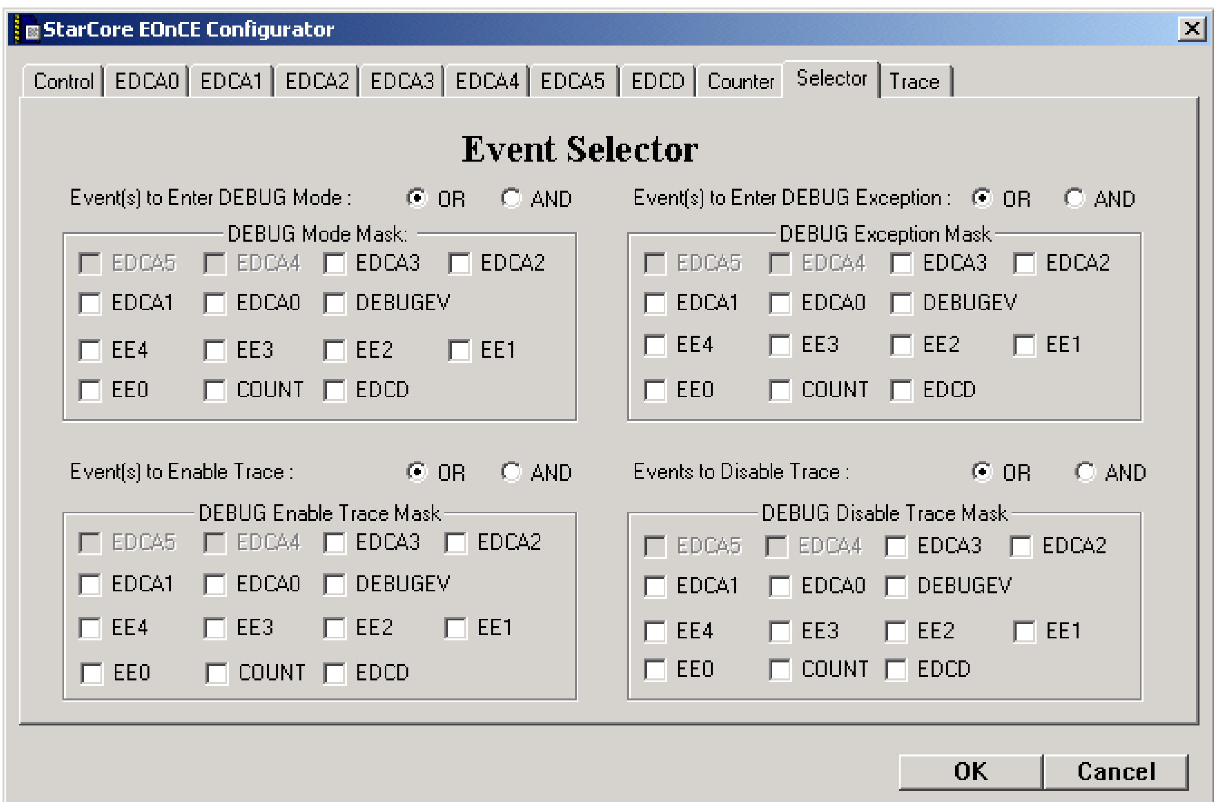


Table 9.5 describes the items that you can specify on the Event Selector panel in the EOnCE Configurator.

Table 9.5 Event Selector Panel

Panel Item	Description
Event(s) to Enter DEBUG Mode	Select OR to indicate that any of the events chosen in DEBUG Mode Mask place the EOnCE module in debug mode. Select AND to indicate that all the events chosen in DEBUG Mode Mask must occur to place the EOnCE module in debug mode.
DEBUG Mode Mask	Place the EOnCE module in debug mode after an event on one or more specified items. You can specify the following items: • EDCA0, EDCA1, EDCA2, EDCA3 • DEBUGEV • EE4, EE3, EE2, EE1, EE0 • Counter • EDCD Click Any to specify one item or All to specify multiple items.
Event(s) to Enter DEBUG Exception	Select OR to indicate that any of the events chosen in DEBUG Exception Mask generate a debugging exception. Select AND to indicate that all the events chosen in DEBUG Exception Mask must occur to generate a debugging exception.
DEBUG Exception Mask	Generate a debug exception after an event on one or more specified items. You can specify the following items: • EDCA0, EDCA1, EDCA2, EDCA3 • DEBUGEV • EE4, EE3, EE2, EE1, EE0 • Counter • EDCD Click Any to specify one item or All to specify multiple items.
Event(s) to Enable Trace	Select OR to indicate that any of the events chosen in DEBUG Enable Trace Mask enable the trace buffer. Select AND to indicate that all the events chosen in DEBUG Enable Trace Mask must occur to enable the trace buffer.

Table 9.5 Event Selector Panel (*continued*)

Panel Item	Description
DEBUG Enable Trace Mask	Enable tracing after an event on one or more specified items. You can specify the following items: • EDCA0, EDCA1, EDCA2, EDCA3 • DEBUGEV • EE4, EE3, EE2, EE1, EE0 • Counter • EDCD Click Any to specify one item or All to specify multiple items.
Events to Disable Trace	Select OR to indicate that any of the events chosen in DEBUG Disable Trace Mask disable the trace buffer. Select AND to indicate that all the events chosen in DEBUG Disable Trace Mask must occur to disable the trace buffer.
DEBUG Disable Trace Mask	Disable tracing after an event on one or more specified items. You can specify the following items: • EDCA0, EDCA1, EDCA2, EDCA3 • DEBUGEV • EE4, EE3, EE2, EE1, EE0 • Counter • EDCD Click Any to specify one item or All to specify multiple items.

Trace Unit panel

With EOnCE, you can collect data in a trace buffer as you debug a program. You can use the Trace Unit panel to choose the trace buffer settings.

Figure 9.6 shows the Trace Unit panel.

Figure 9.6 EOnCE Configurator Trace Unit Panel

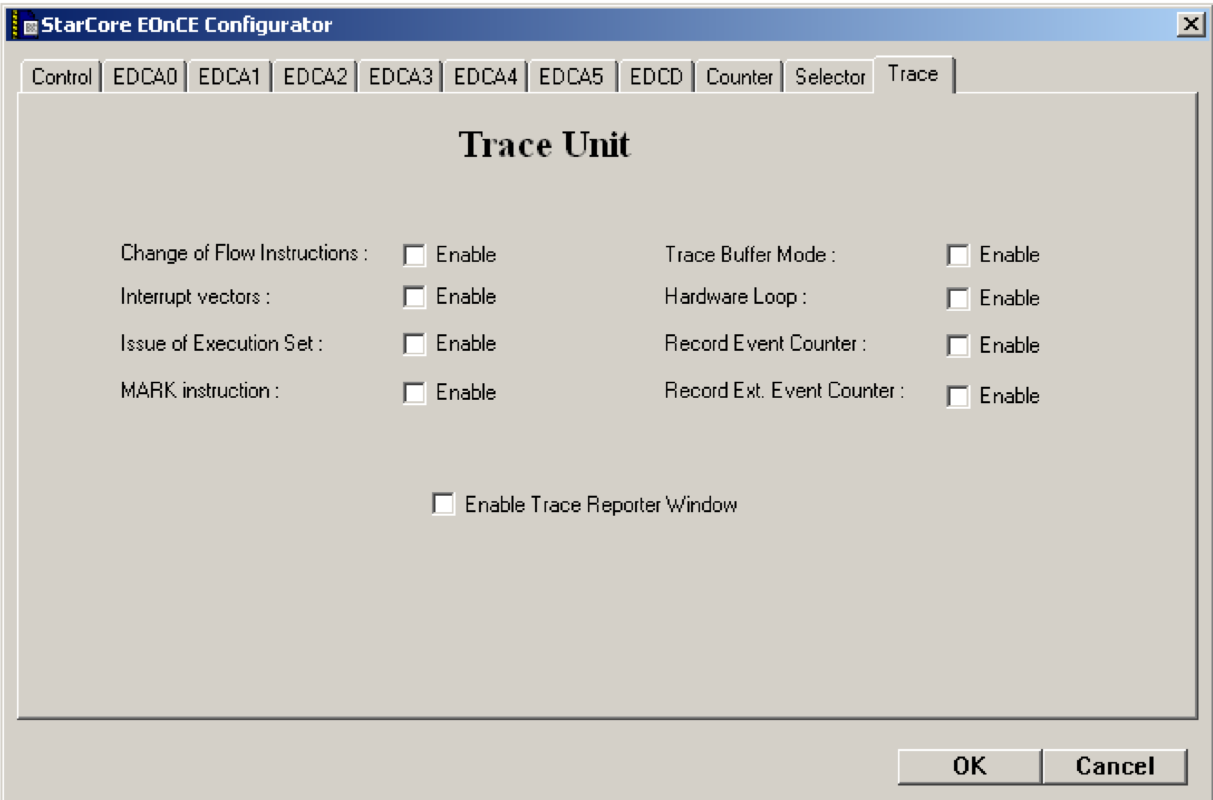


Table 9.6 describes the items that you can specify on the Trace Unit panel in the EOnCE Configurator.

Table 9.6 Trace Unit Panel Description

Panel Item	Description
Change of Flow Instructions	Enables a tracing mode that traces the addresses of execution sets containing change of flow instructions (for example, a jump, branch, or return to subroutine instruction). The CodeWarrior IDE places the address of the first instruction of such an execution set in the trace buffer.
Interrupt Vectors	Enables a tracing mode that traces the address of interrupt vectors. When enabled, each service of an interrupt places the following items in the trace buffer: • The address of the last executed execution set (before the interrupt) • The address of the interrupt vector
Issue of Execution Set	Enables a tracing mode that traces the addresses of every issued execution set. The only entry written to the trace buffer while tracing in this mode is the first address of each execution set.
MARK Instruction	Enables the EOnCE MARK instruction, which writes the PC (program counter) to the trace buffer if the trace buffer is enabled.
Trace Buffer Mode	Enables the trace buffer so that it collects data.
Hardware Loop	Enables a tracing mode that traces the addresses of hardware loops. Every change of flow resulting from a loop puts the address of the last address into the trace buffer.
Record Event Counter	Enables a tracing mode that causes each destination address placed in the trace buffer to be followed immediately by the value of the event counter register. If you enable Buffer Counter and Buffer Extension Counter at the same time, the value of the event counter register precedes the value of the extension counter register in the trace buffer.
Record Ext. Event Counter	Enables a tracing mode that causes each destination address placed in the trace buffer to be followed immediately by the value of the extension counter register.
Enable Trace Reporter Window	Causes a Trace Reporter window to display when you debug a program with EOnCE trace buffer settings selected.

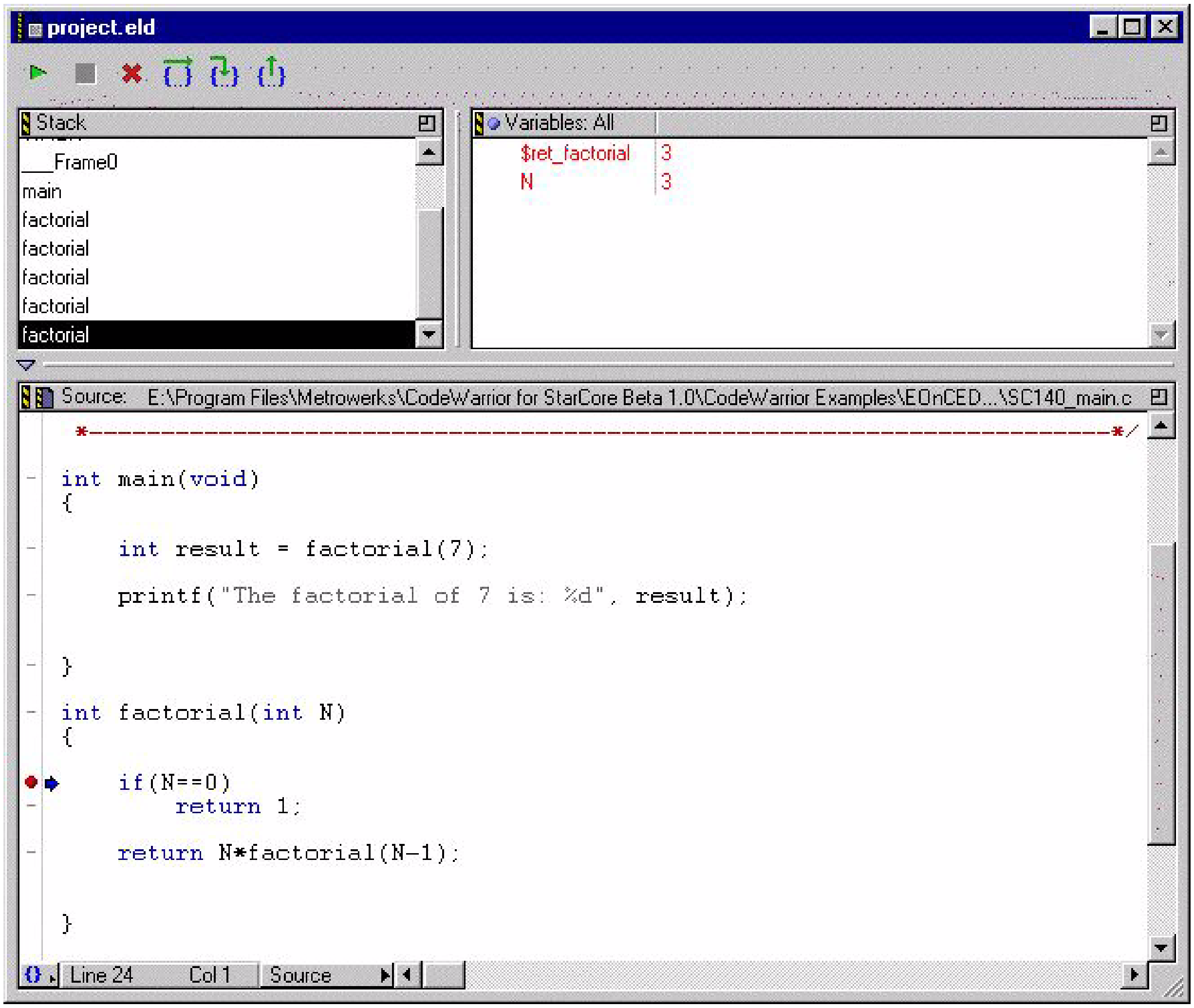
EOnCE Example: Counting Factorial Function Calls

This example shows how to count calls to a factorial function in a recursive factorial program.

To run the factorial program with an input of 7 and count the calls to the `factorial` function five times using a regular software breakpoint, you would set a breakpoint on the first line of the factorial function. Each time the IDE reaches the breakpoint, it stops and you must click the debug button to continue execution. This is a time-consuming process.

Figure 9.7 shows the Thread window after counting the call to `factorial` five times using a regular software breakpoint.

Figure 9.7 Thread Window: Counting with a Regular Software Breakpoint



However, when you use EOnCE, you can pre-set the condition (count the call to the function five times) and location where you want the IDE to count the call to the function. The count occurs automatically each time execution reaches that location.

After the fifth call, the program stops executing and the IDE enters debug mode. The example in this section discusses how to set up this condition using EOnCE. After you set up the condition, you can execute much faster than by starting the program running again each time it stops on the breakpoint.

This example includes the following topics, which you must perform in the listed order:

1. Open the EOnCEDemo project
2. Download the EOnCEDemo project
3. Get the address of the instruction
4. Open the EOnCE Configurator
5. Configure the Address Event Detection Channel 0 panel
6. Configure the Event Counter panel
7. Configure the Event Selector panel
8. Save EOnCE Configurator settings
9. Run the EOnCE factorial count debugging example

Open the EOnCEDemo Project

To open the EOnCEDemo project:

1 If needed, open CodeWarrior™ for the StarCore™ DSP.

2 Choose **File > Open**.

3 Navigate to the following directory:

Windows *CodeWarrior_dir*`\Examples\StarCore\EOnCEDemo`

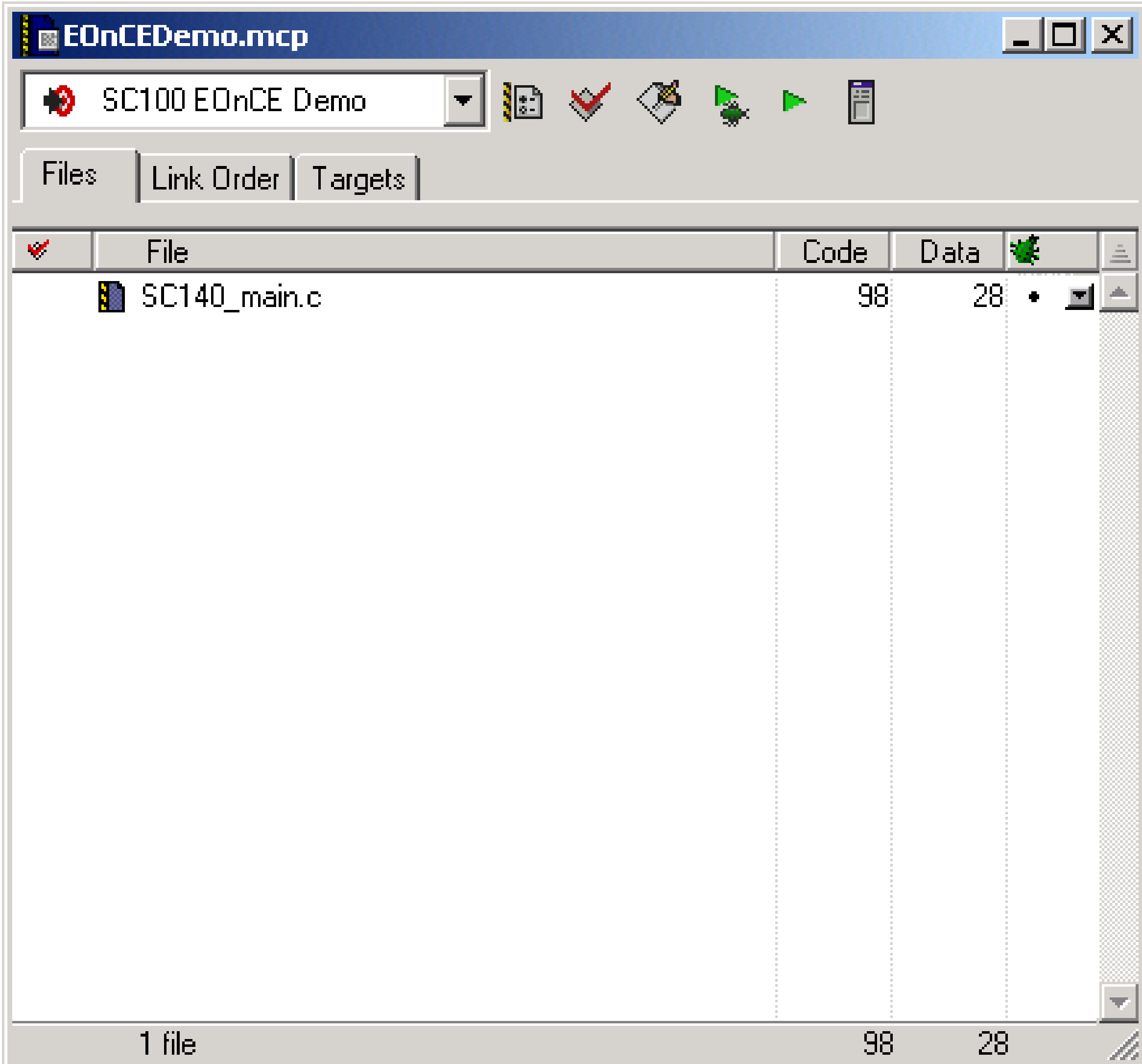
Solaris *install_dir/CodeWarrior_ver_dir*`/CodeWarrior_Examples/EOnCEDemo`

4 Select the project file (`EOnCEDemo.mcp`).

5 Click Open.

When you open the project, the IDE displays a Project window as shown in Figure 9.8.

Figure 9.8 EOnCEDemo.mcp Project Window



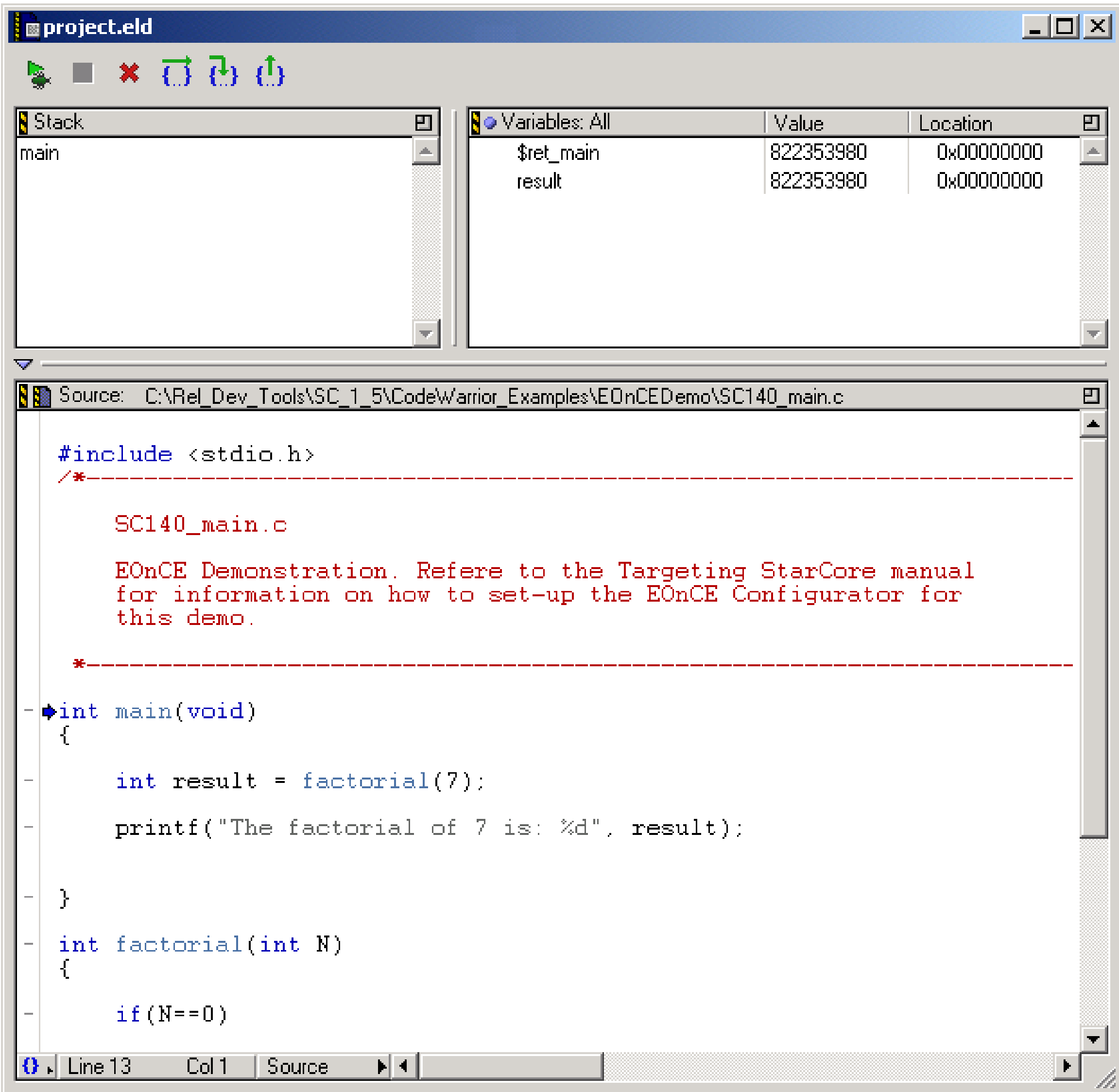
Download the EOnCEDemo Project

To download the EOnCEDemo project, choose **Project > Debug**.

The IDE downloads the project to the target board, and the Thread window appears as shown in Figure 9.9.

NOTE You must download your program to the target board before configuring EOnCE debugging conditions.

Figure 9.9 Thread Window for the EOnCEDemo Project



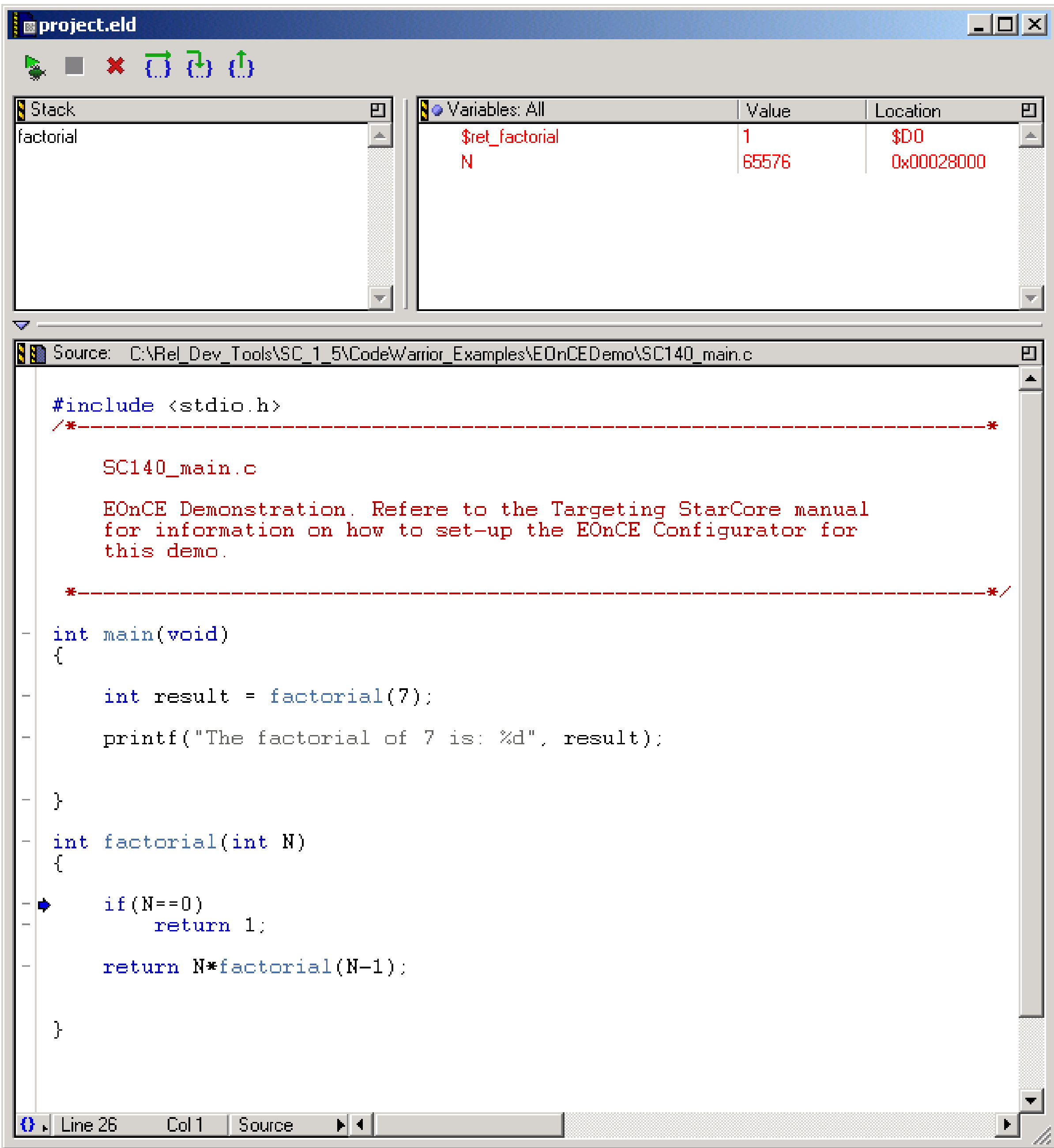
Get the Address of the Instruction

To get the address of the instruction to specify as the location where EOnCE counts the call to the factorial function:

1. In the Thread window, move the Current Statement arrow to the first line of the factorial function (the instruction where you want to set the breakpoint).

   Figure 9.10 shows the Thread window after you move the arrow.

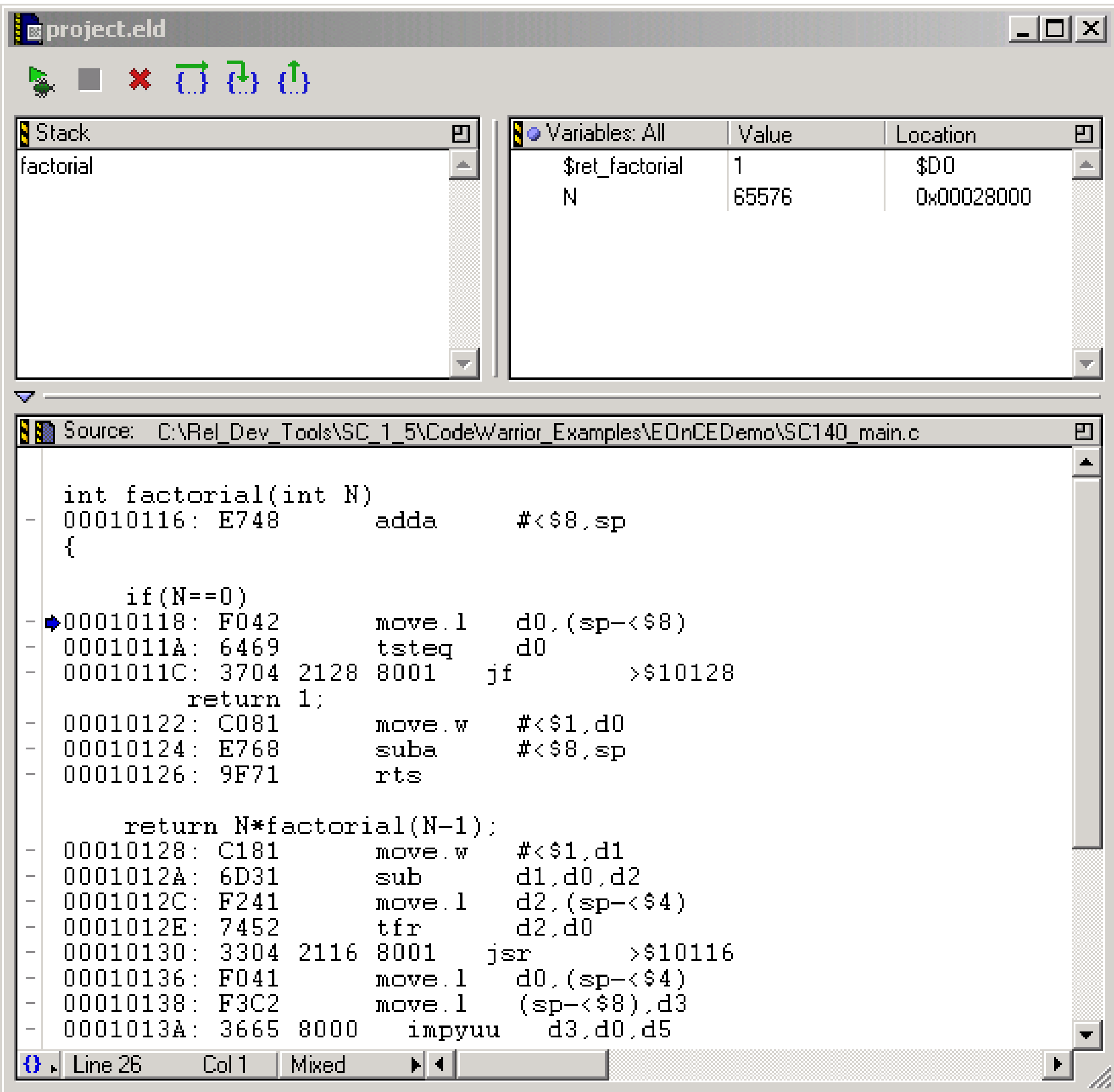
Figure 9.10 Current Statement Arrow: First Line of the Factorial Function



2 At the bottom of the Thread window, click the Source pop-up menu and choose Mixed.

The IDE displays a mixed view of C source and assembly code as shown in Figure 9.11. The Current Statement arrow points to the address of the instruction on which you want to set the breakpoint.

Figure 9.11 Thread Window Displaying a Mixed Code View



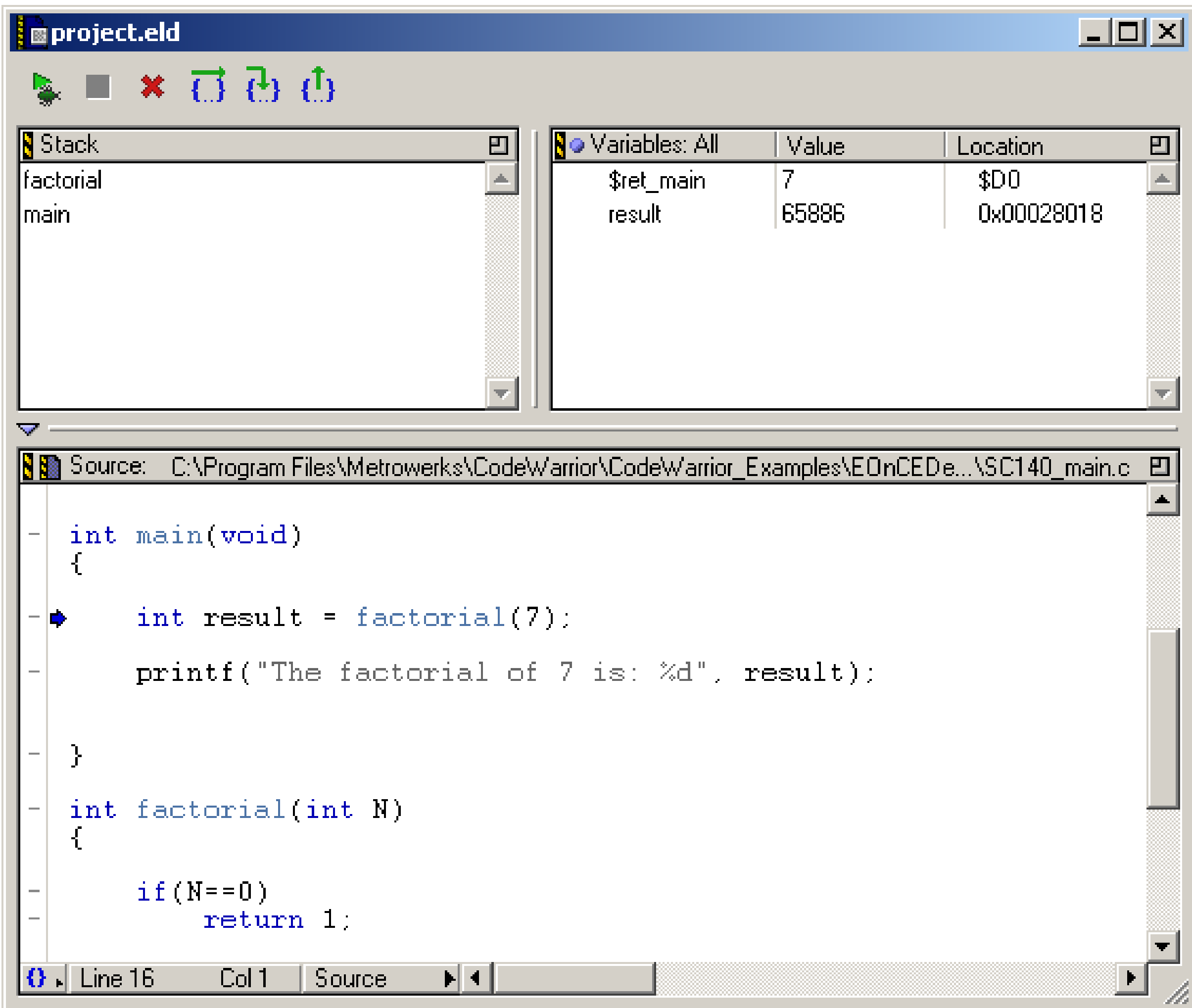
3 Write down the address value for the instruction immediately preceding the location to which the Current Statement arrow points.

4 Switch back to the source view.

5 Move the Current Statement arrow to the first statement in the `main` function.

Figure 9.12 shows the appearance of the Thread window after you make the change.

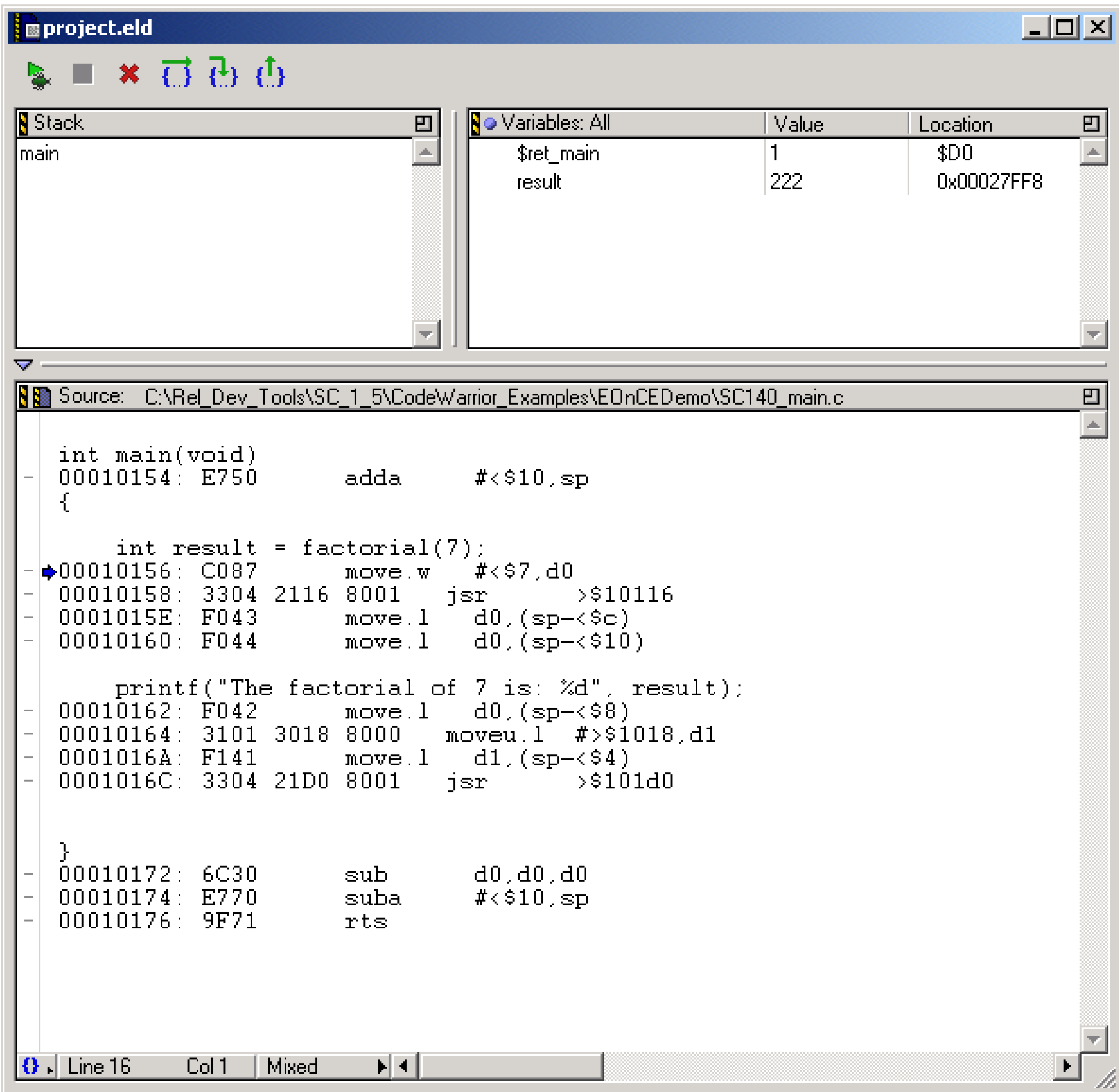
Figure 9.12 Current Statement Arrow on the First Statement in main()



6 At the bottom of the Thread window, click the Source pop-up menu and choose Mixed.

Figure 9.13 shows the appearance of the Thread window after you make the change.

Figure 9.13 Thread Window Displaying a Mixed Code View



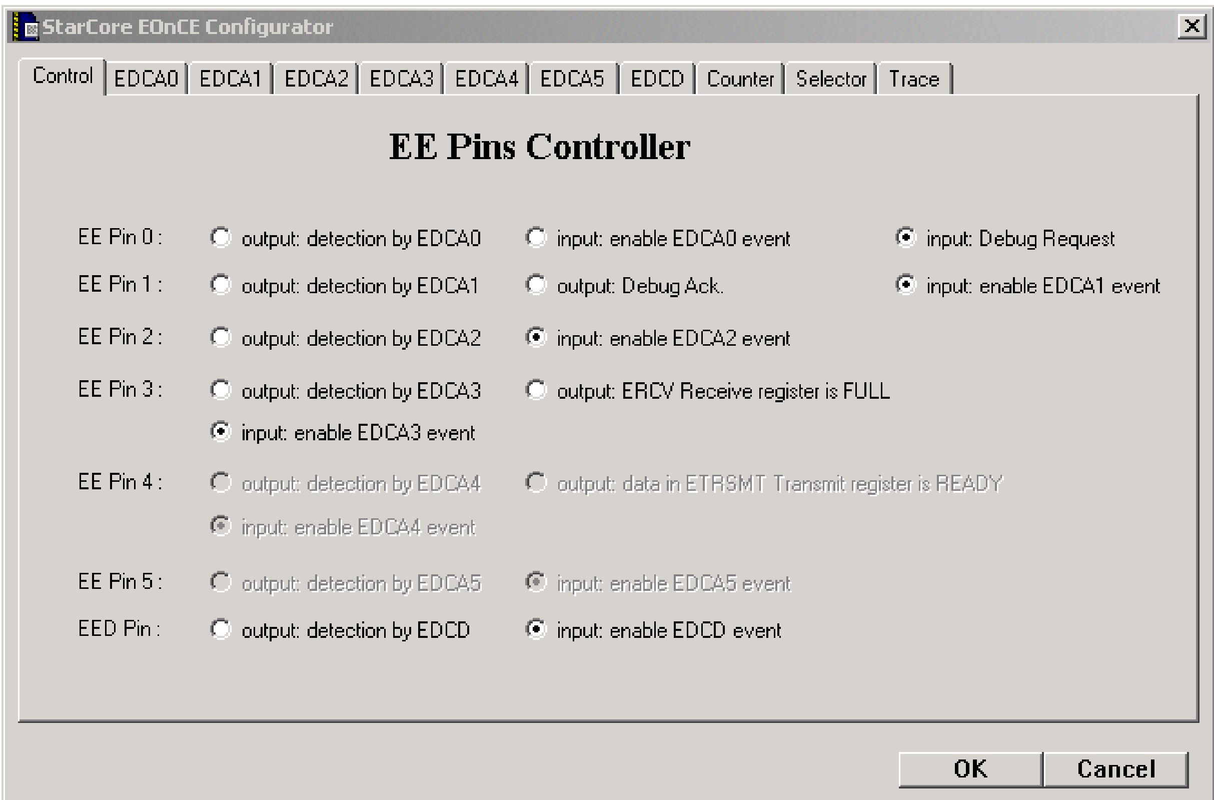
Open the EOnCE Configurator

You can use the EOnCE Configurator to set various conditions to perform EOnCE debugging.

To open the EOnCE Configurator, choose **Debug > EOnCE > EOnCE Configurator**.

The IDE displays the EOnCE Configurator window as shown in Figure 9.14.

Figure 9.14 EE Pins Controller Panel



The window initially displays the EE Pins Controller panel, which you can use to configure the EOnCE controller, specifically the EE pins. EE pins are general-purpose pins that can serve as input or output pins to the EOnCE.

NOTE For this example, the settings on the EE Pins Controller panel are not relevant; do not change them.

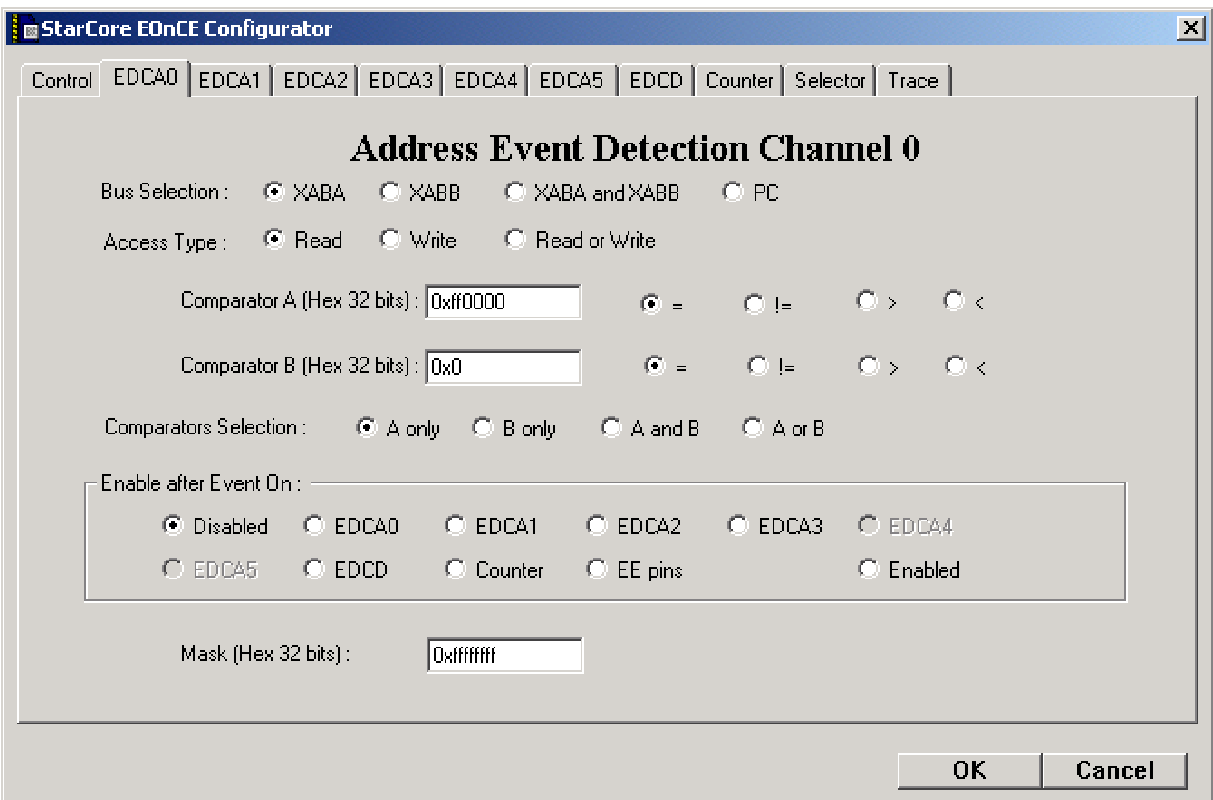
Configure the Address Event Detection Channel 0 Panel

To choose settings for the address event detection channel 0 by configuring the Address Event Detection Channel 0 panel:

1. Click the EDCA0 tab.

   The IDE displays the chosen panel as shown in Figure 9.15.

Figure 9.15 Address Event Detection Channel 0 Panel



2. To set a breakpoint on an instruction, click PC as the Bus Selection.

NOTE When selecting settings in the EOnCE Configurator, configure the tabbed panels in the left-to-right order of the tabs. For example,

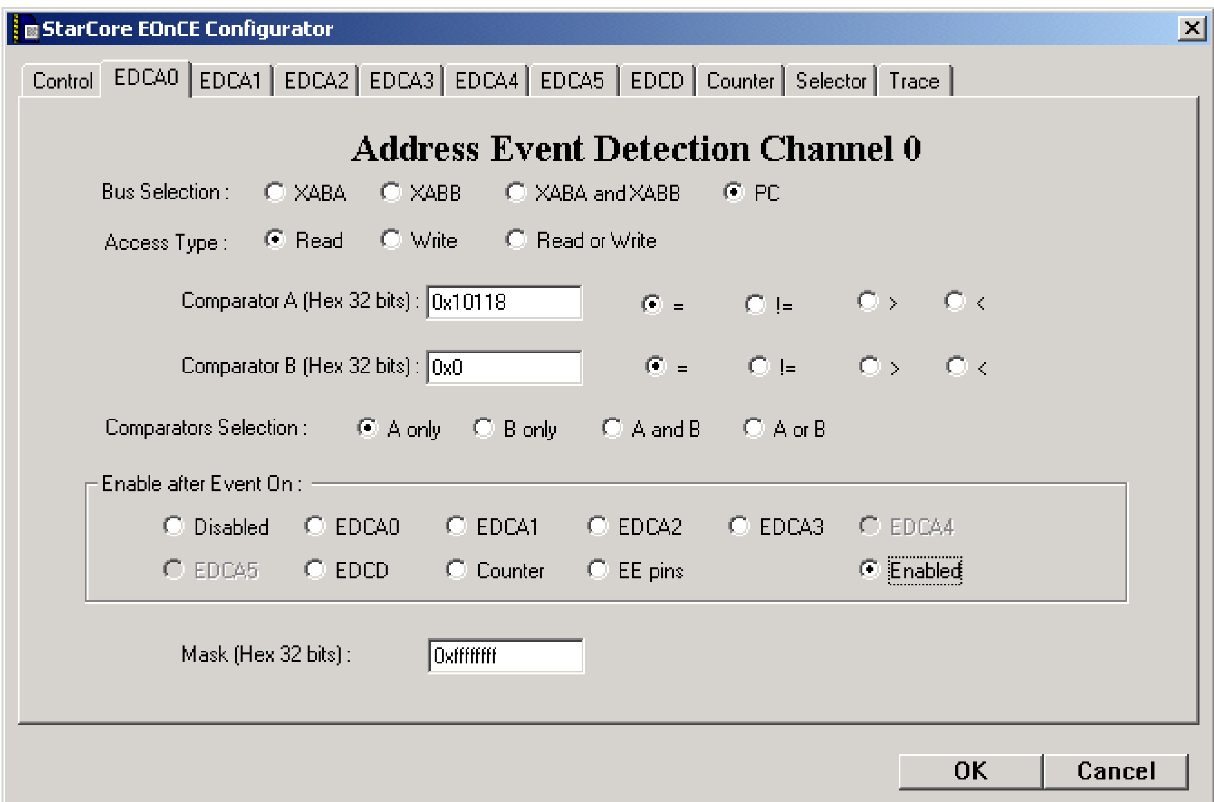
configure the Address Event Detection Channel 0 panel before configuring the Event Counter panel. In addition, within a panel, configure your selected settings from the left-top to right-bottom position.

3 Type the address value of the instruction you previously noted in the Comparator A field in hexadecimal format.

4 For Enable after Event On, click Enabled.

For the other settings, use the defaults. The panel now appears as shown in Figure 9.16.

Figure 9.16 Address Event Detection Channel 0 after Changing Settings



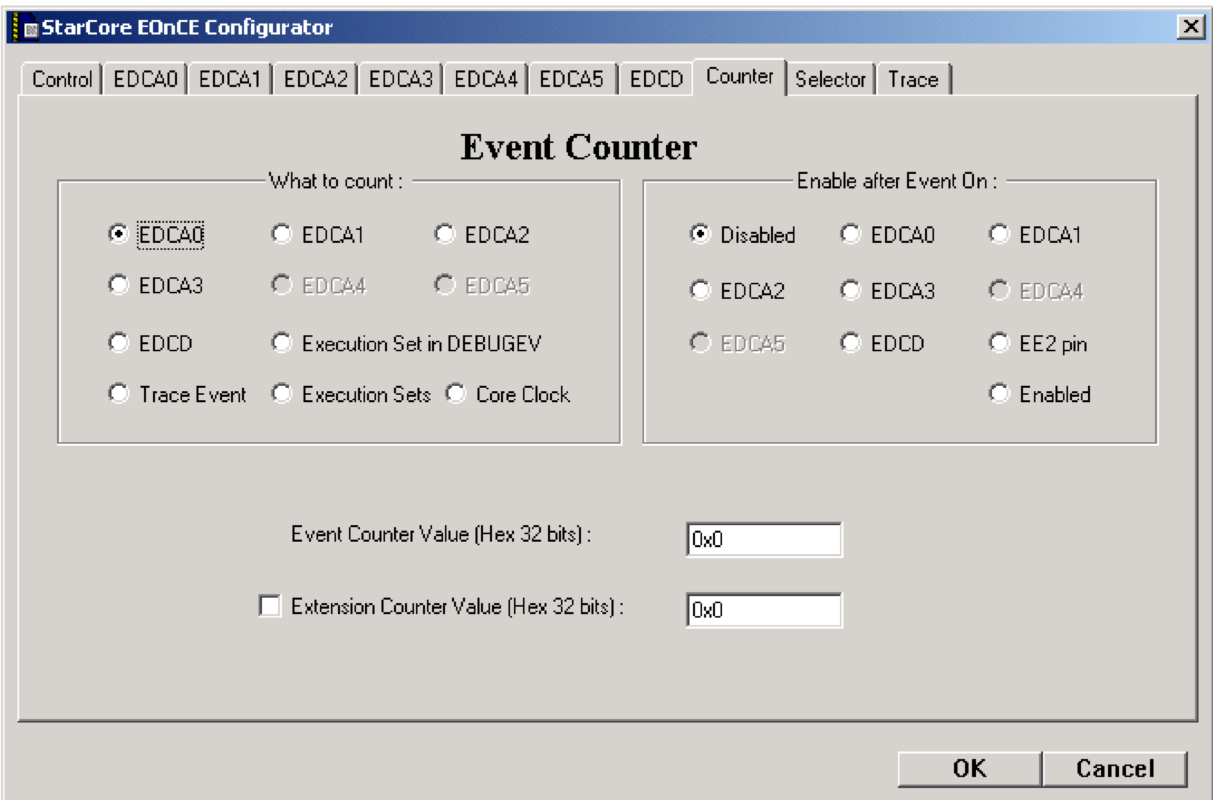
Configure the Event Counter Panel

To configure the Event Counter panel to count a particular event on address channel 0:

1. Click the Counter tab to display the Event Counter panel.

   The IDE displays the Event Counter panel as shown in Figure 9.17.

Figure 9.17 Event Counter Panel



By default, the Event Counter panel specifies to count EDC0 (address channel 0, which corresponds with the Address Event Detection Channel 0 panel that you just configured and is correct for this example).

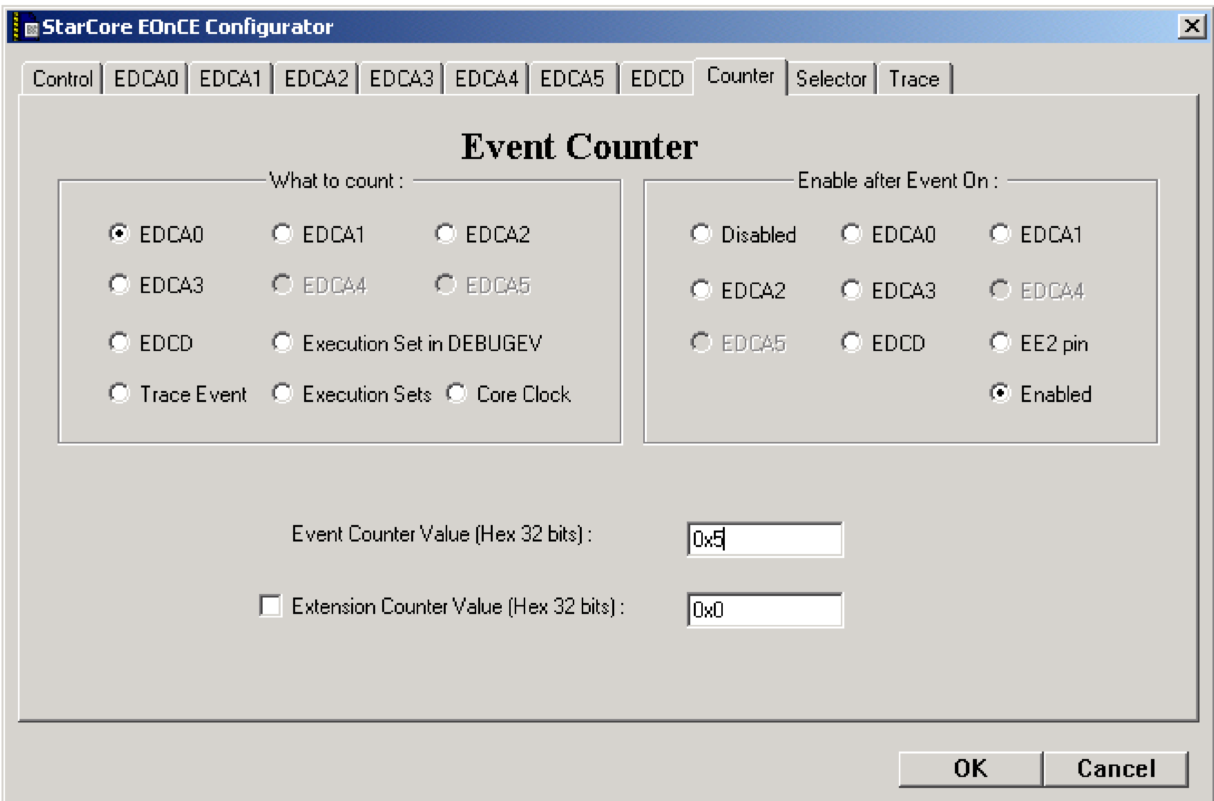
2. For Enable after Event On, click Enabled.

3 Type the hexadecimal value for how many times you want to count in the Event Counter Value (Hex 32 bits) field. For this example, type:

```
0x5
```

Figure 9.18 shows the appearance of the Event Counter panel after your changes.

Figure 9.18 Event Counter Panel after Changing Settings



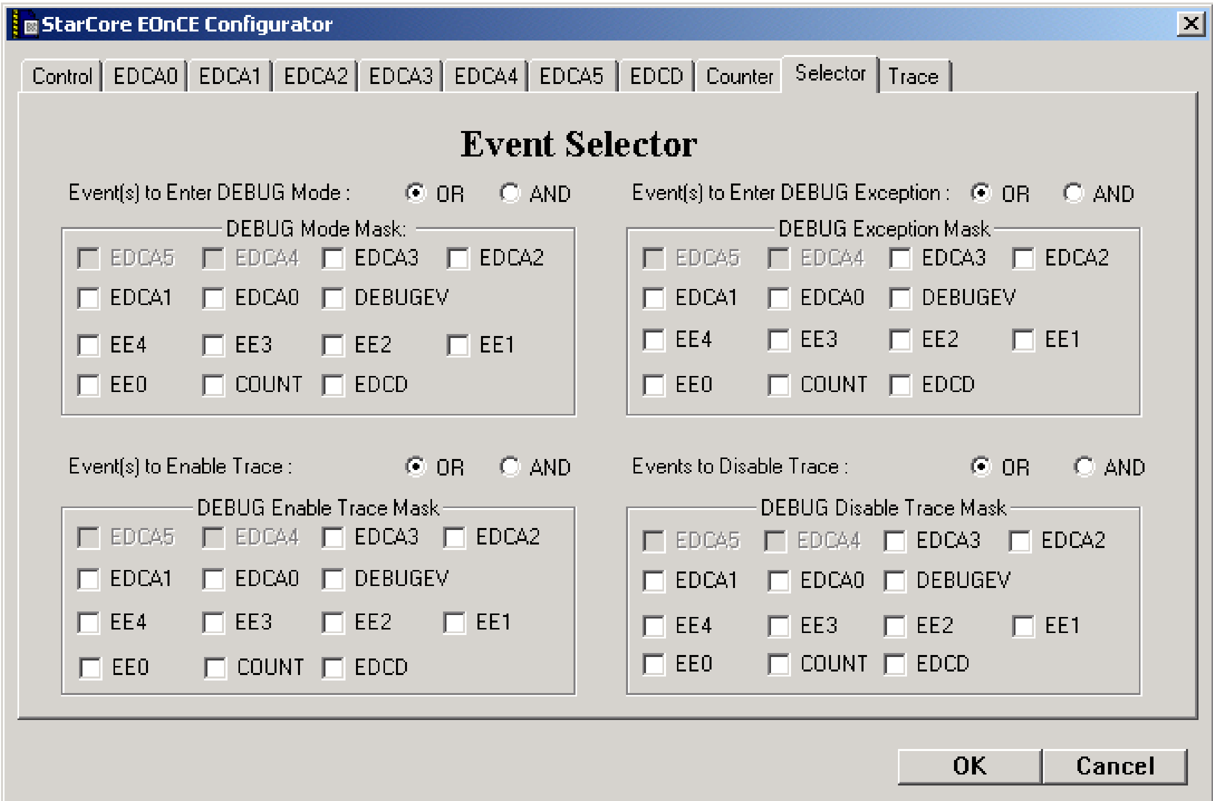
Configure the Event Selector Panel

To configure the Event Selector panel:

1 Click the Selector tab to display the Event Selector panel.

The IDE displays the Event Selector panel as shown in Figure 9.19.

Figure 9.19 Event Selector Panel



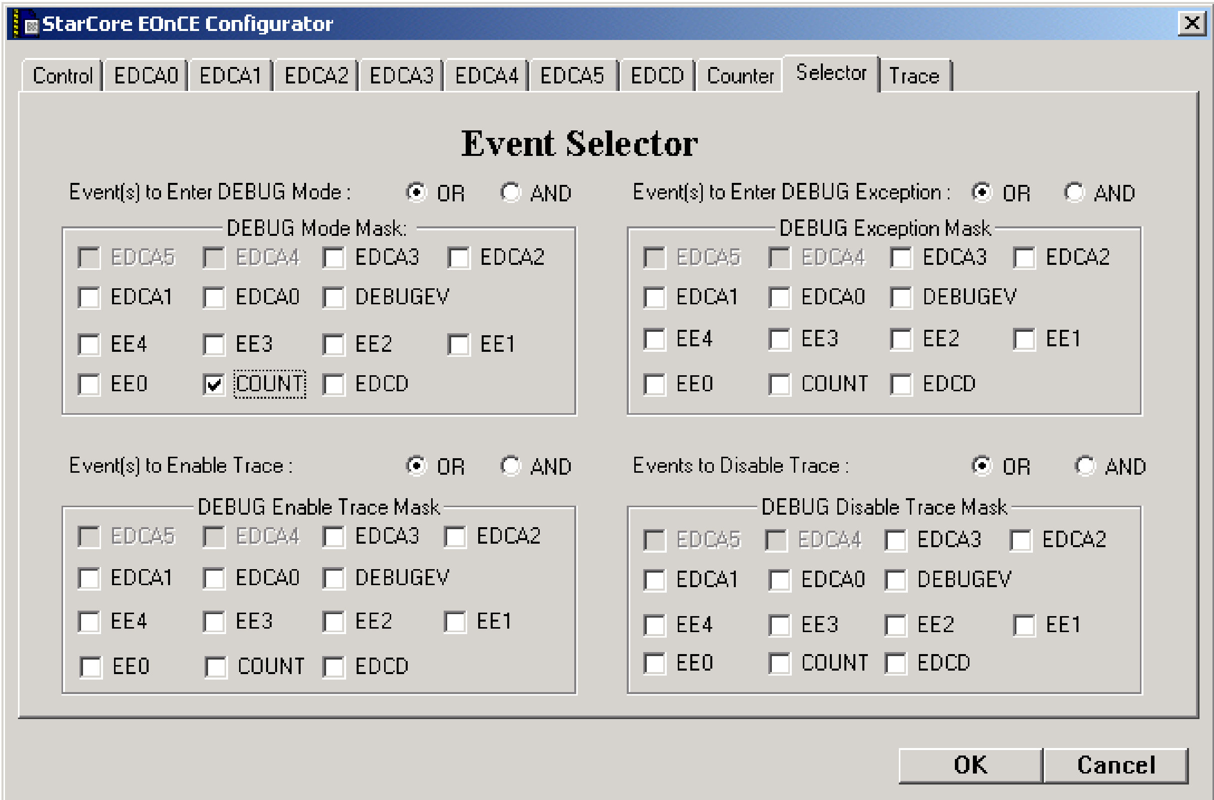
The default setting for Event(s) to Enter DEBUG Mode is OR, which is correct for this example.

2 In DEBUG Mode Mask, click the COUNT checkbox (to enable it).

The Event(s) to Enter DEBUG Mode setting and the DEBUG Mode Mask setting halt the CPU and cause the EOnCE module to enter debug mode when the condition or conditions that you set are met.

Figure 9.20 shows the appearance of the Event Selector panel after this change.

Figure 9.20 Event Selector Panel after Changing Settings



Save the EOnCE Configurator Settings

To save your changes, click OK in the EOnCE Configurator window.

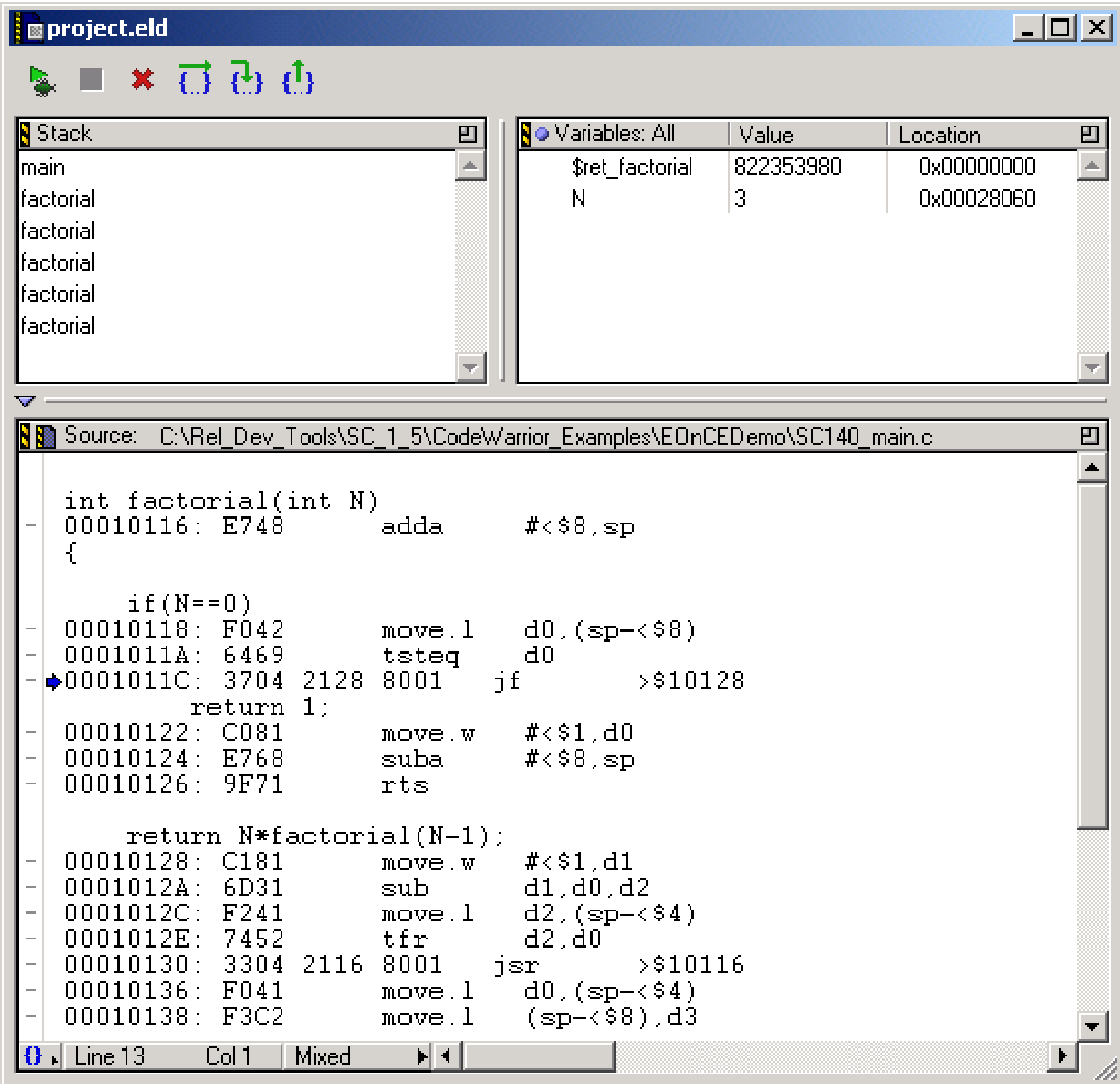
Run the EOnCE Factorial Count Debugging Example

To run the EOnCE debugging example, select **Project > Run**.

The debugger executes the program, and five calls to the factorial function appear in the Stack Crawl pane before the program stops running and enters debug mode.

Figure 9.21 shows the appearance of the Thread window after you run the debugging example.

Figure 9.21 Thread Window after Running the Debugging Example



In this example, the program halted in debug mode; therefore, you can continue debugging from that point.

EOnCE Example: Using the Trace Buffer

This example shows how to capture data in the EOnCE trace buffer and examine it.

This section includes the following topics, which you must perform in the listed order:

1. Open the EOnCEDemo project
2. Download the EOnCEDemo project
3. Set a breakpoint
4. Run to the breakpoint
5. Open the EOnCE Configurator
6. Configure a trace
7. Save EOnCE Configurator settings
8. Run the EOnCE trace buffer debugging example

Open the EOnCEDemo Project

To open the EOnCEDemo project:

1 If needed, open CodeWarrior™ for the StarCore™ DSP.

2 Choose **File > Open**.

3 Navigate to the following directory:

Windows *CodeWarrior_dir*`\Examples\StarCore\EOnCEDemo`

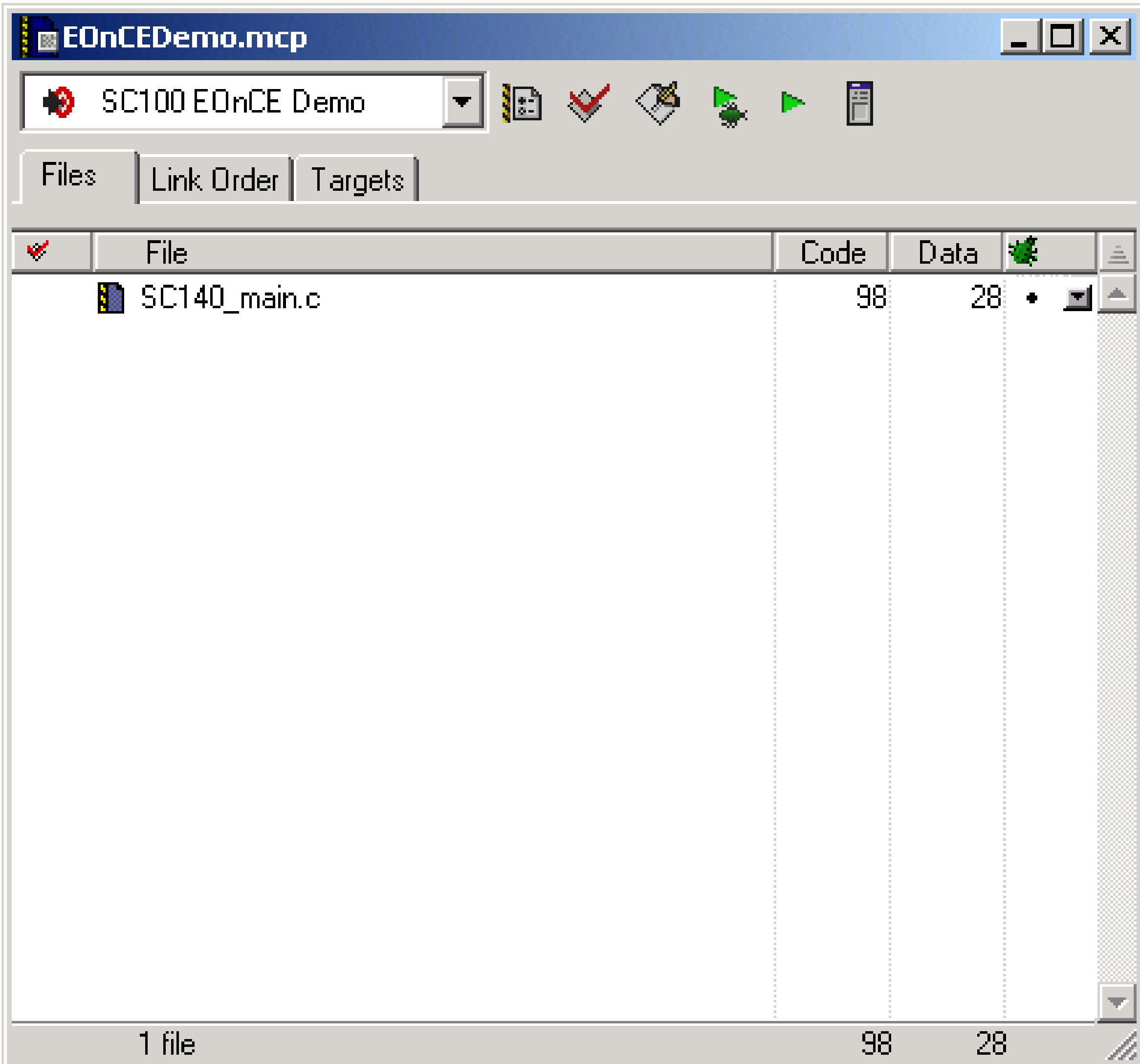
Solaris *install_dir/CodeWarrior_ver_dir*`/CodeWarrior_Examples/EOnCEDemo`

4 Select the project file (`EOnCEDemo.mcp`).

5 Click Open.

The IDE displays a Project window as shown in Figure 9.22.

Figure 9.22 EOnCEDemo.mcp Project Window



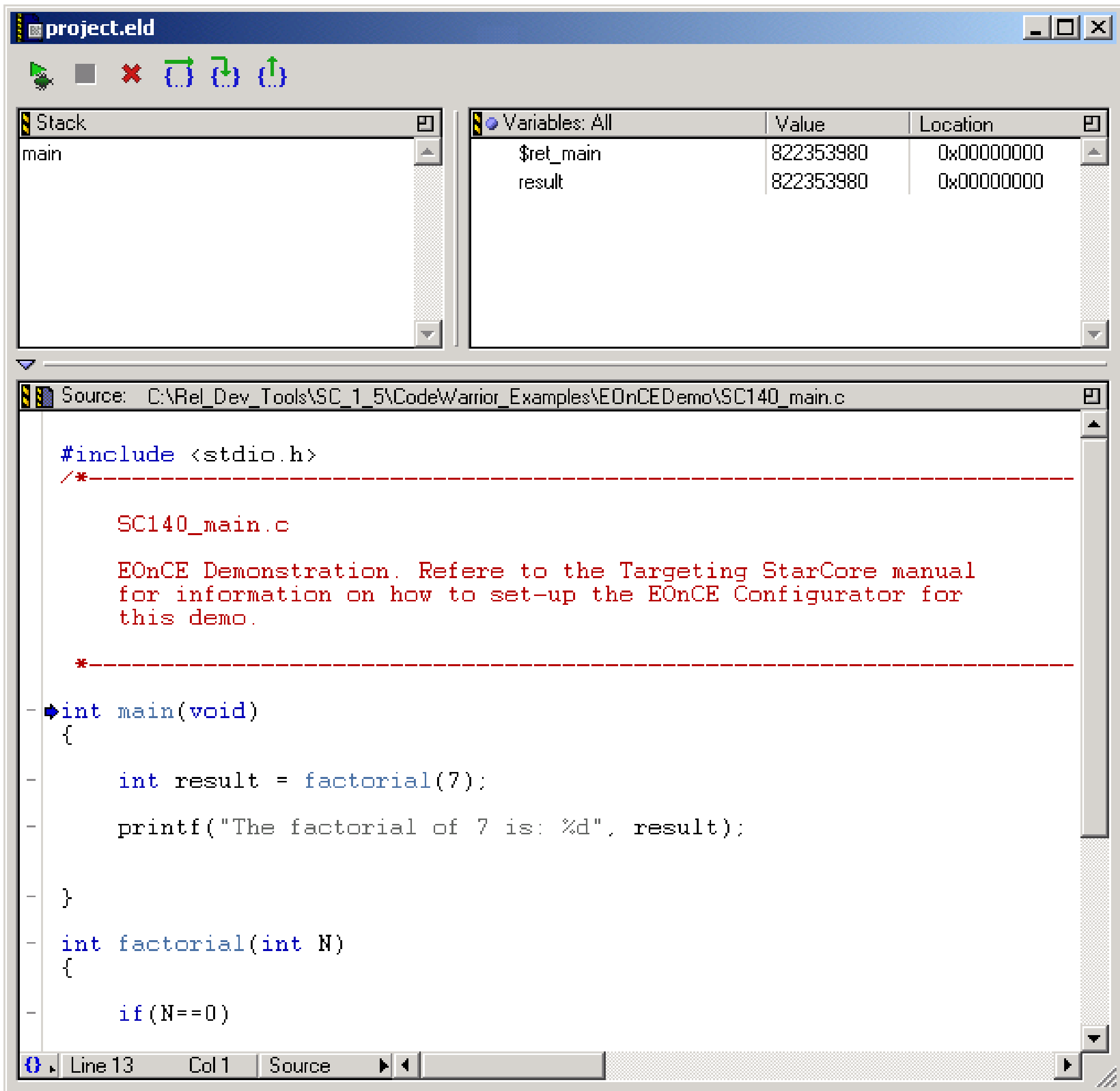
Download the EOnCEDemo Project

To download the EOnCEDemo project, choose **Project > Debug**.

The IDE downloads the project to the target board, and the Thread window appears as shown in Figure 9.23.

NOTE You must download your program to the target board before configuring EOnCE debugging conditions.

Figure 9.23 Thread Window for the EOnCEDemo Project



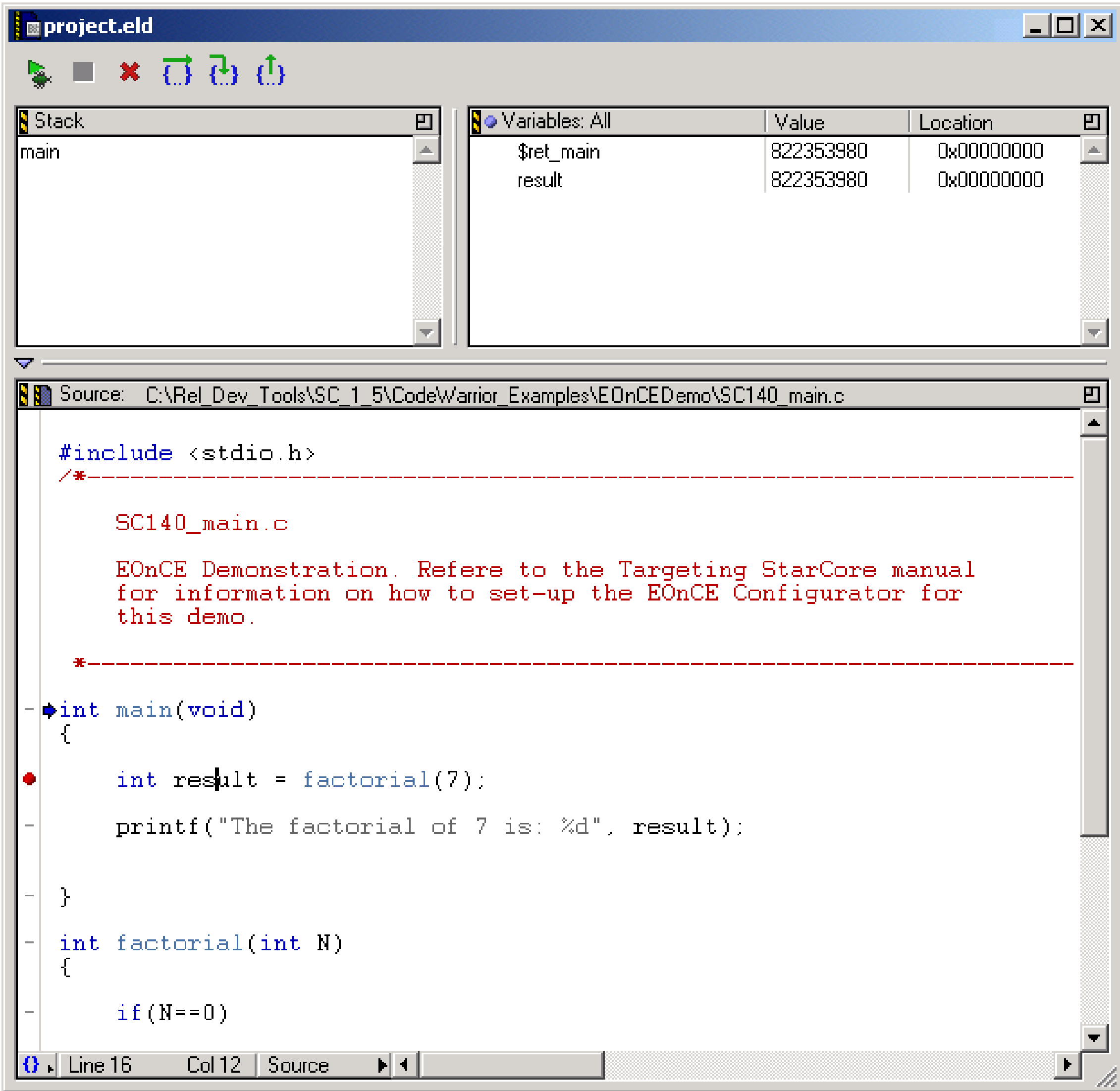
Set a Breakpoint

Click on the gray dash next to the following line of code in the Thread window to set a breakpoint:

```
int result = factorial (7);
```

Figure 9.24 shows the Thread window after you set the breakpoint.

Figure 9.24 Thread Window after Setting the Breakpoint

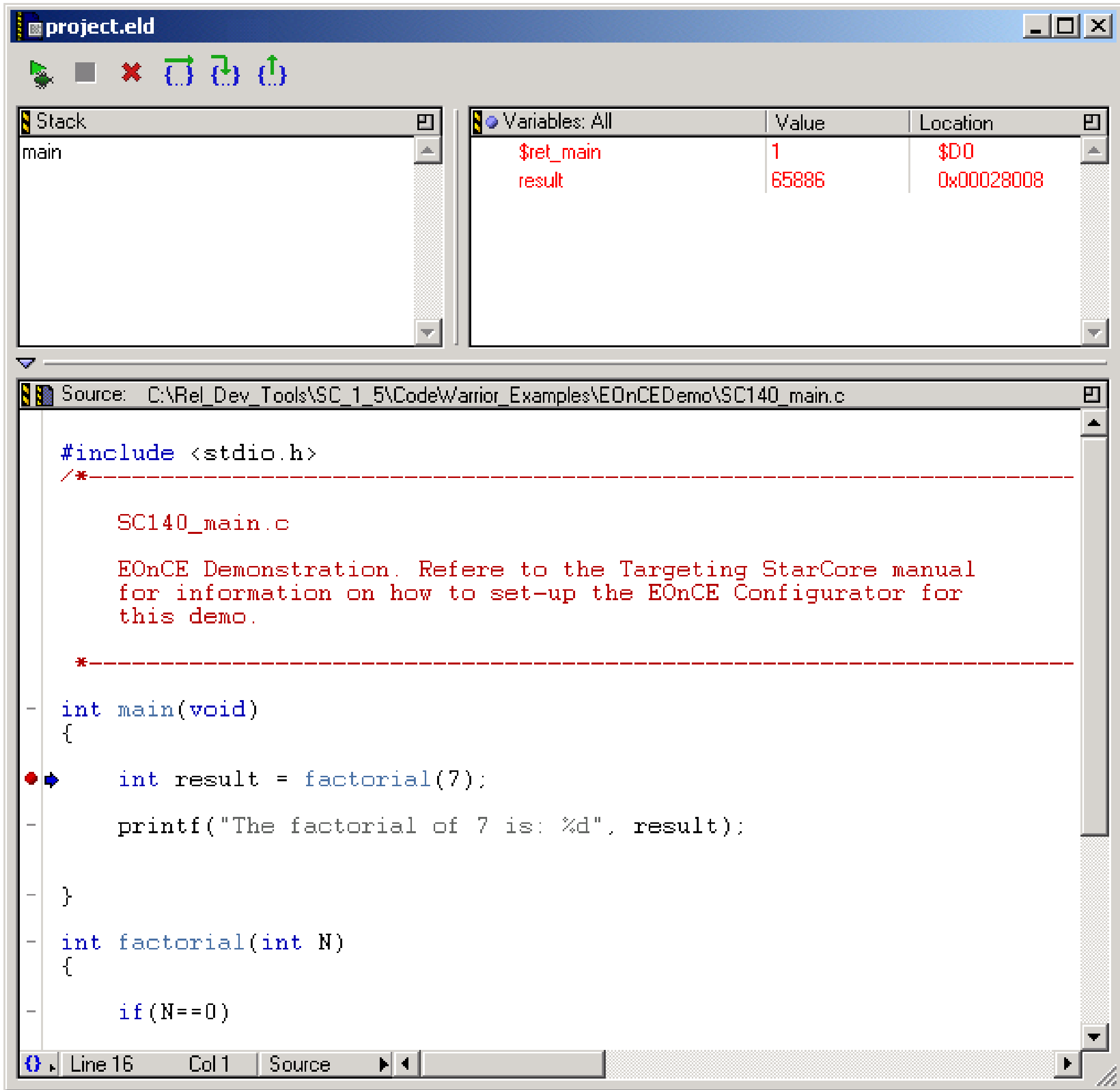


Run to the Breakpoint

Choose **Project > Run** to run to the breakpoint you previously set.

Figure 9.25 shows the Thread window after running to the breakpoint.

Figure 9.25 Thread Window after Running to the Breakpoint



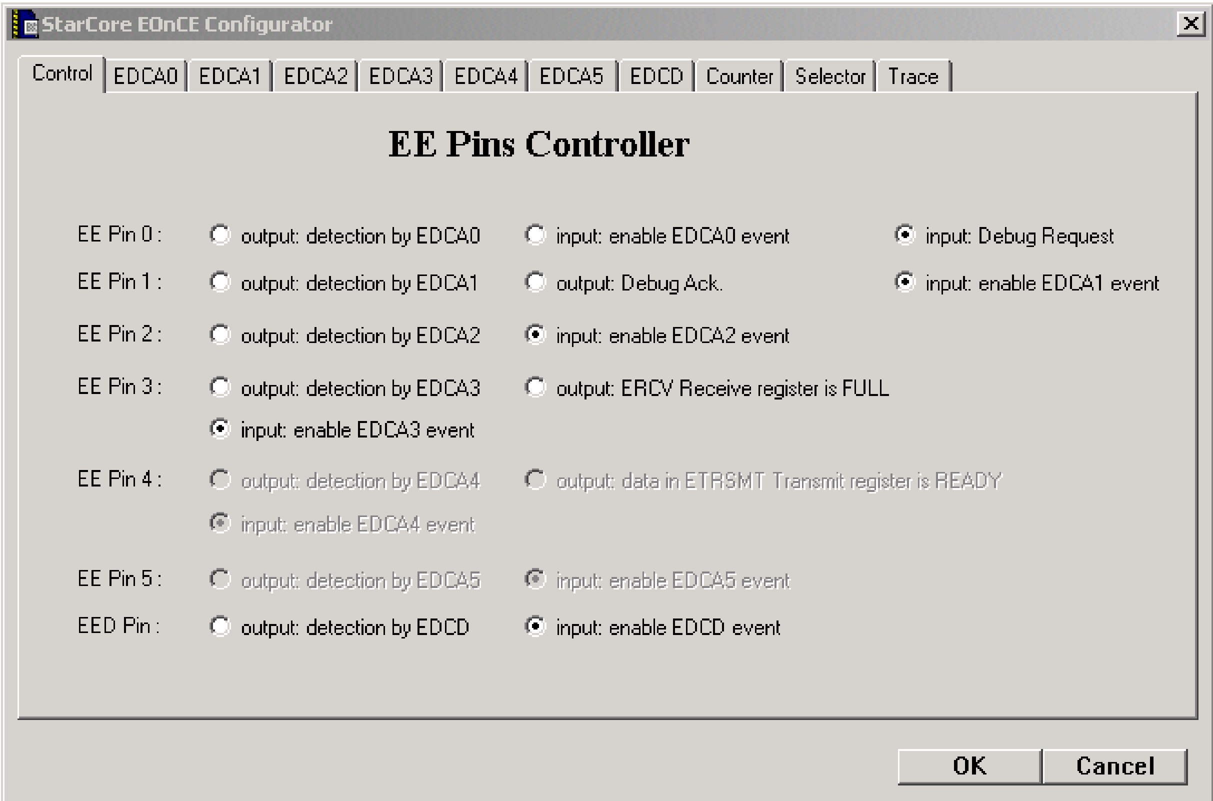
Open the EOnCE Configurator

You can use the EOnCE Configurator to set the various conditions to perform EOnCE debugging.

To open the EOnCE Configurator, choose **Debug > EOnCE > EOnCE Configurator**.

The IDE displays the EOnCE Configurator window as shown in Figure 9.26.

Figure 9.26 EE Pins Controller Panel



The window initially displays the EE Pins Controller panel, which you can use to configure the EOnCE controller, specifically the EE pins. EE pins are general-purpose pins that can serve as input or output pins to the EOnCE.

NOTE For this example, the default settings for the EE Pins Controller panel as shown in Figure 9.26 are correct; do not change them.

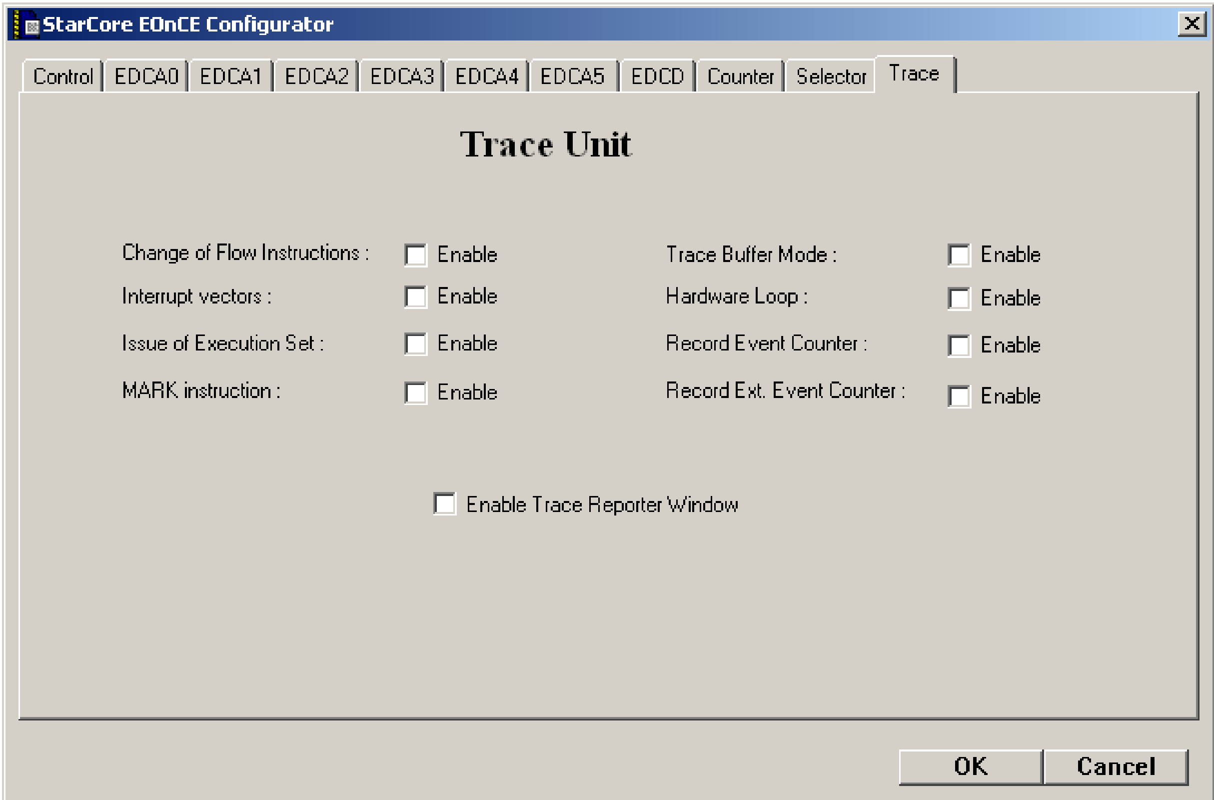
Configure a Trace

To configure the trace for this example:

1. Click the Trace tab to display the Trace Unit panel.

   Figure 9.27 shows the initial Trace Unit panel.

Figure 9.27 EOnCE Configurator Trace Unit Panel



2. Click the Change of Flow Instructions checkbox to enable it.

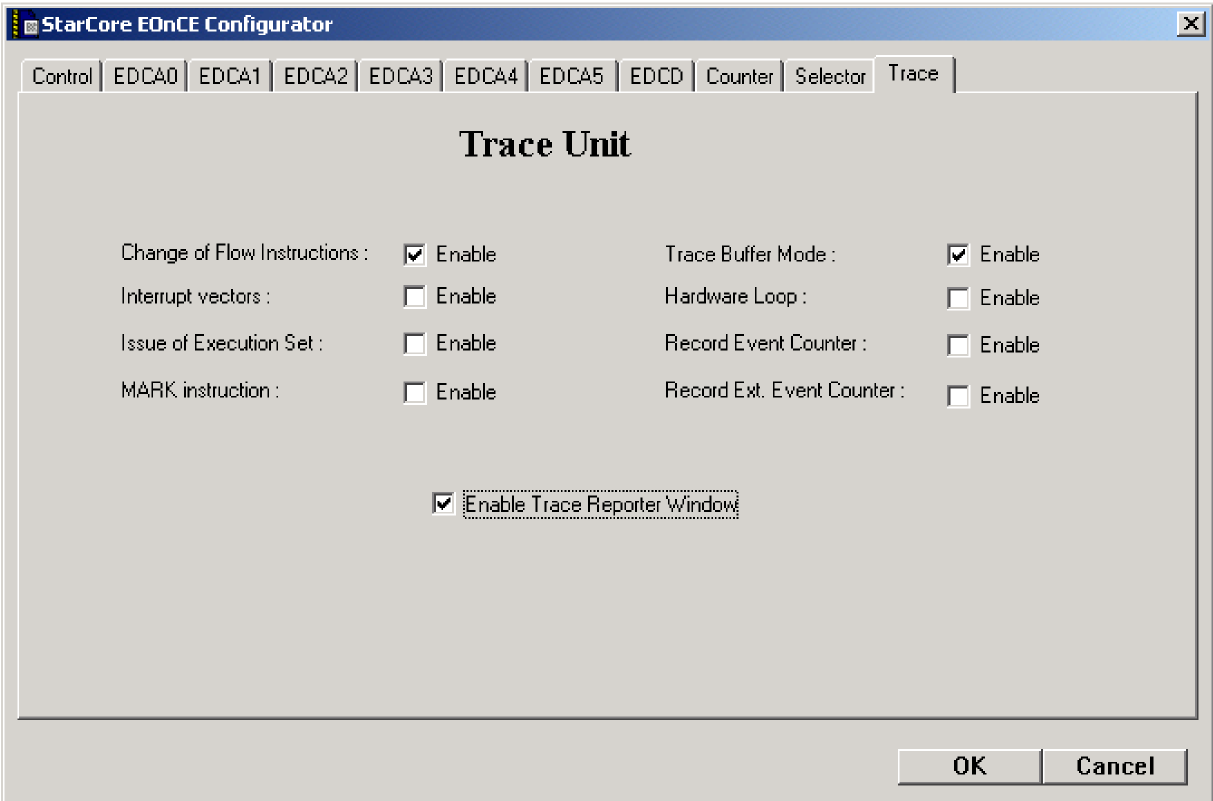
   This enables a trace on anything that changes the instruction flow (for example, a jump, branch, or return to subroutine instruction).

3. Click the Trace Buffer Mode checkbox to enable it.

4. Click the Enable Trace Reporter Window checkbox to enable it.

   Figure 9.28 shows the Trace Unit panel after configuration.

Figure 9.28 EOnCE Configurator Trace Unit Panel after Configuration



Save the EOnCE Configurator Settings

To save your changes, click OK in the EOnCE Configurator window.

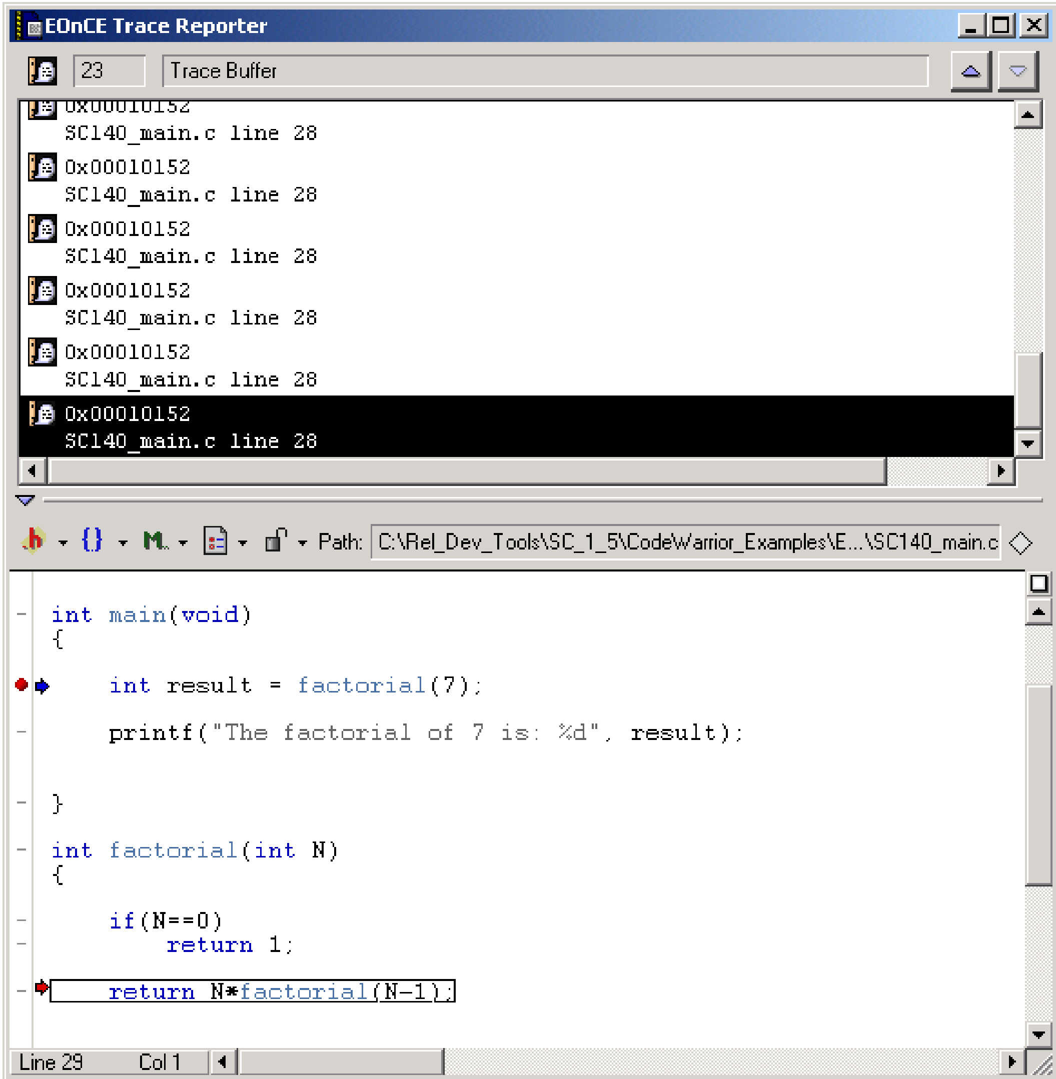
Run the EOnCE Trace Buffer Debugging Example

To run the EOnCE trace buffer debugging example, choose **Debug > Step Over**.

The IDE steps over one instruction.

The debugger displays an EOnCE Trace Reporter window. Figure 9.29 shows the appearance of the EOnCE Trace Reporter window.

Figure 9.29 EOnCE Trace Reporter Window



10

Code Profiler

This chapter describes how to use the CodeWarrior code profiler to collect statistics and information about your code

The topics in this chapter are:

Profiler Examples

The following directory contains example programs that you can compile and examine with the profiler:

CodeWarrior_dir`\Examples\StarCore\Profiler`

Launching the Profiler

Before using the profiler, you must compile your executable file with symbolics in the output file.

The IDE automatically does this when you indicate in the Debug column of the Project window that the IDE should generate debugging information for a given file before compiling your code. (Use the `-g` command line switch if you are compiling on the command line).

NOTE If your program makes `printf` calls to `stdout`, the output appears in a standard IDE I/O window. (This can be useful for marking the progress of your profiling execution.)

After you compile your program correctly, you can launch the profiler.

To launch the profiler:

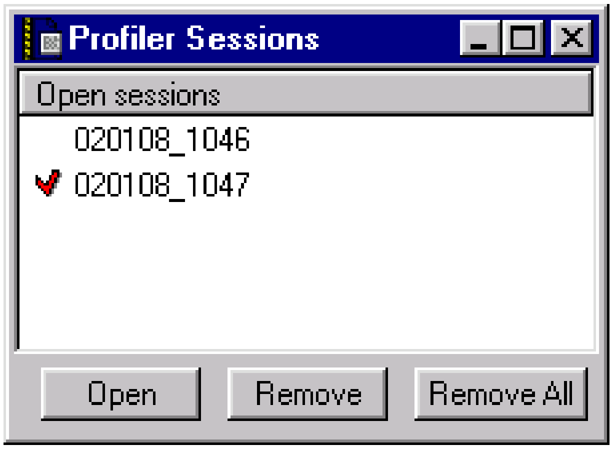
1. Open a project.

2. Select the Launch Profiler checkbox on the SC100 Debugger Target panel.

3. Choose **Project > Debug**.

   The IDE displays the Profiler Sessions window (Figure 10.1), which contains a list of open profiler sessions.

Figure 10.1 Profiler Sessions Window

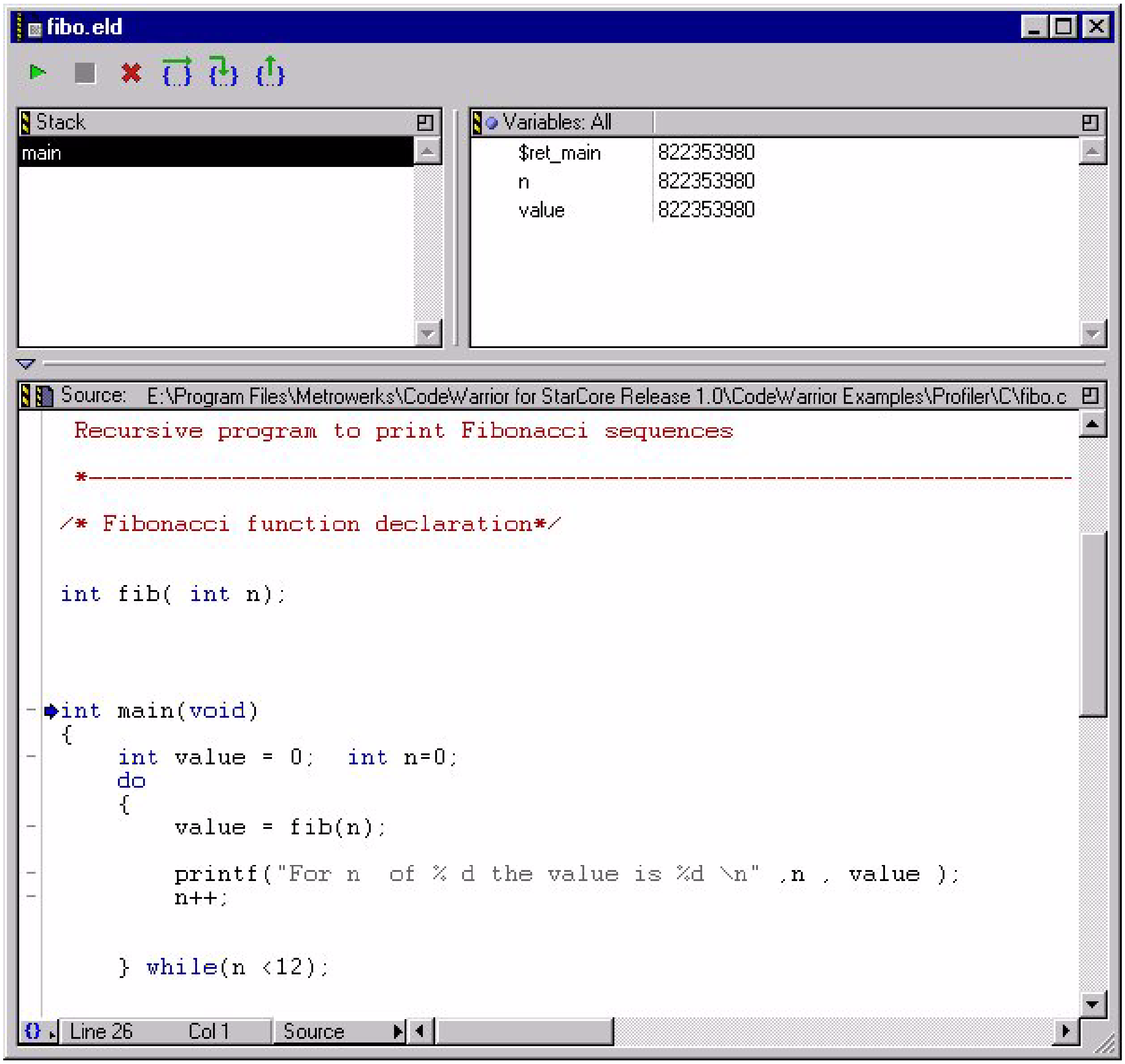


The check mark in the Profiler Sessions window indicates the currently active session.

The IDE begins executing your program and displays a standard Thread window similar to the one shown in Figure 10.2.

NOTE You can use all the standard IDE debugging commands after the Thread window appears.

Figure 10.2 Thread Window Displayed after Starting the Profiler



NOTE When you debug a multi-core project, the project that specifies the location of the other projects that are part of the multi-core project on its Other Executables target settings panel is the master project.

If you are debugging a multi-core project, downloading the master project may cause the other projects in the multi-core project to be downloaded as well. In this case, if you are using the profiler to

download the master project, the profiler profiles all the projects in the multi-core project. Each of those projects has a separate listing in the Profiler Sessions window.

Opening a Profiler Sessions Window

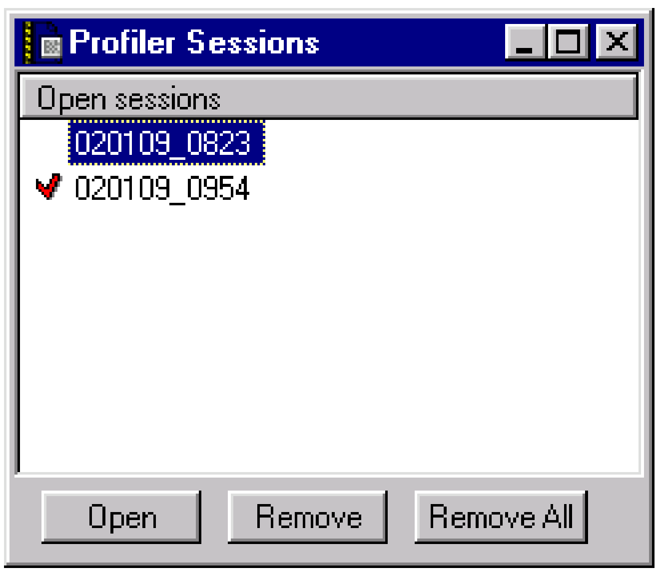
To open the Profiler Sessions window, choose **Profiler > Sessions**.

Removing a Profiler Session

To remove a profile from the Profiler Sessions window (Figure 10.1), perform these steps:

1. Click the name of any profiler session to highlight it. Figure 10.1 shows a Profiler Sessions window after highlighting the session.

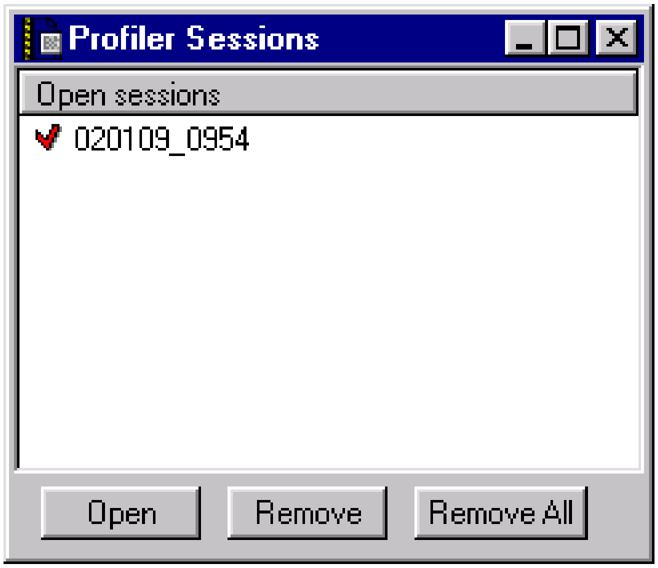
Figure 10.3 Profiler Sessions Window with Session Name Highlighted



2. Click Remove.

   The IDE removes the session from the Profiler Sessions window and closes all other profiler windows related to that session. Figure 10.4 shows the Profiler Sessions window after you delete the chosen session.

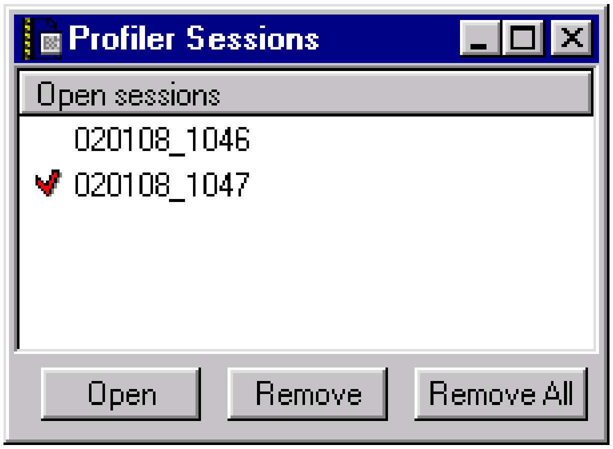
Figure 10.4 Profiler Sessions Window After Removing a Session



Removing All Profiler Sessions

To remove all profiler sessions from a Profiler Sessions window (Figure 10.1), click Remove All.

Figure 10.5 Profiler Sessions Window



The IDE removes all sessions from the Profiler Sessions window and closes all other profiler windows related to those sessions.

View a List of Functions

To view a list of functions, perform any of these actions:

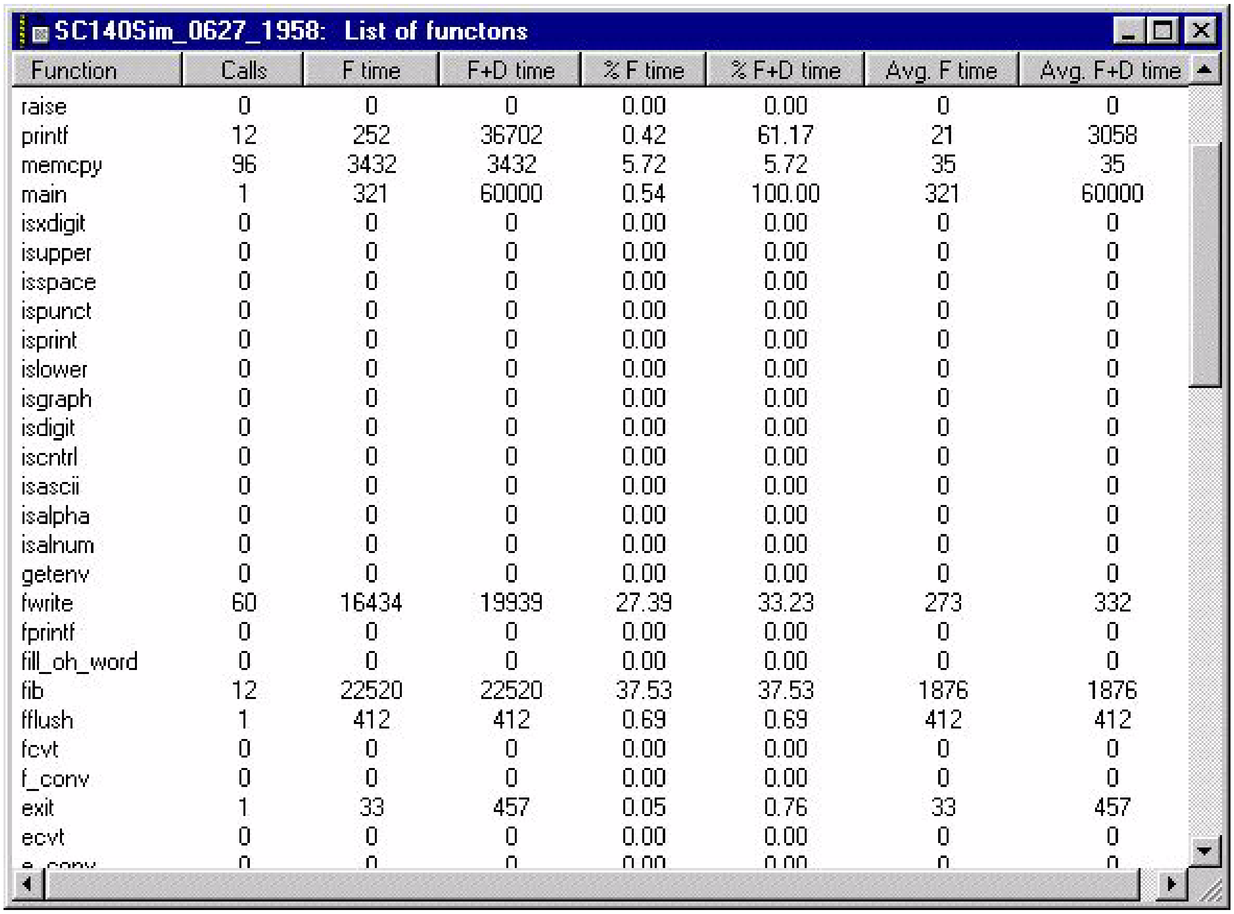
- Choose **Profiler > Functions**.

NOTE The IDE applies the Functions command to the currently selected profile in the Profiler Sessions window (indicated by a check mark next to the name of the session).

- In the Profiler Sessions window, highlight the name of a profiler session and click Open.
- In the Profiler Sessions window, double-click the name of a profiler session.

The CodeWarrior IDE displays a list of functions window similar to the one shown in Figure 10.14.

Figure 10.6 The List of Functions Window



Function	Calls	F time	F+D time	% F time	% F+D time	Avg. F time	Avg. F+D time
raise	0	0	0	0.00	0.00	0	0
printf	12	252	36702	0.42	61.17	21	3058
memcpy	96	3432	3432	5.72	5.72	35	35
main	1	321	60000	0.54	100.00	321	60000
isxdigit	0	0	0	0.00	0.00	0	0
isupper	0	0	0	0.00	0.00	0	0
isspace	0	0	0	0.00	0.00	0	0
ispunct	0	0	0	0.00	0.00	0	0
isprint	0	0	0	0.00	0.00	0	0
islower	0	0	0	0.00	0.00	0	0
isgraph	0	0	0	0.00	0.00	0	0
isdigit	0	0	0	0.00	0.00	0	0
iscntrl	0	0	0	0.00	0.00	0	0
isascii	0	0	0	0.00	0.00	0	0
isalpha	0	0	0	0.00	0.00	0	0
isalnum	0	0	0	0.00	0.00	0	0
getenv	0	0	0	0.00	0.00	0	0
fwrite	60	16434	19939	27.39	33.23	273	332
fprintf	0	0	0	0.00	0.00	0	0
fill_oh_word	0	0	0	0.00	0.00	0	0
fib	12	22520	22520	37.53	37.53	1876	1876
fflush	1	412	412	0.69	0.69	412	412
fcvt	0	0	0	0.00	0.00	0	0
f_conv	0	0	0	0.00	0.00	0	0
exit	1	33	457	0.05	0.76	33	457
ecvt	0	0	0	0.00	0.00	0	0
e_conv	0	0	0	0.00	0.00	0	0

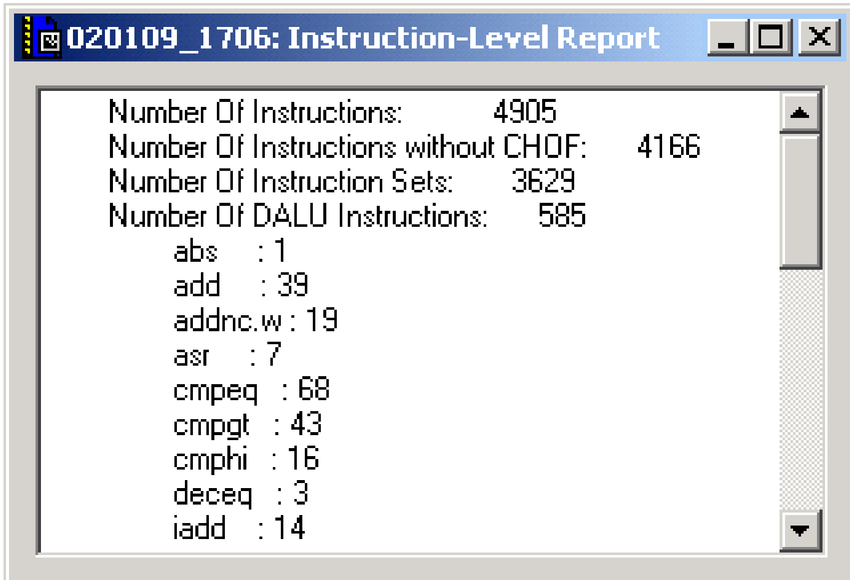
View an Instruction-Level Report

To view an instruction-level report, choose **Profiler > Instructions**.

NOTE The IDE applies the Instructions command to the currently selected profile in the Profiler Sessions window (indicated by a check mark next to the name of the session).

An Instruction-Level Report window similar to the one in Figure 10.9 appears.

Figure 10.7 Instruction-Level Report Window



The Instruction-Level Report window contains the following types of information:

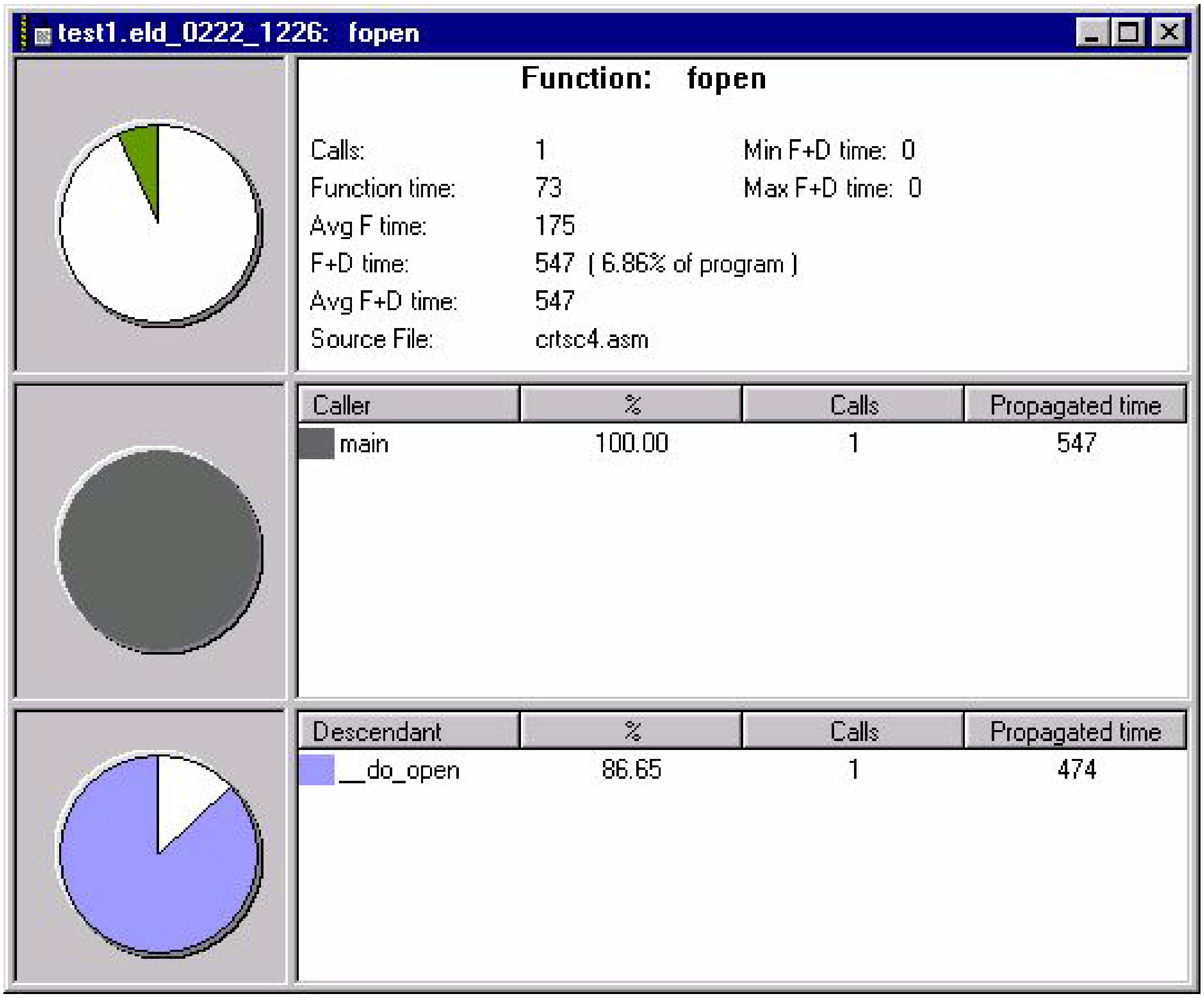
- The number of instructions executed
- The number of instructions executed without change of flow instructions
- The number of instruction sets executed
- A list of executed instructions grouped by type
- A parallel ratio that is calculated by dividing the total number of instructions without change-of-flow instructions by the total number of instruction sets without change-of-flow instructions.

View Function Details

To view detailed information about a function, double-click a function in a List of Functions window or a Function Call Tree window.

The Function Details window appears as shown in Figure 10.8.

Figure 10.8 The Function Details Window



The Function Details window displays information (in graphical and tabular formats) about:

- A particular function
- The immediate callers of that function
- Descendants of that function

For the selected function, the Function Details window displays detailed performance information. The pie chart represents the percentage of total execution time used by the function and its descendants.

For caller functions, the Function Details window displays the following information:

- A list of immediate callers
- The number of times each caller performed a call to the selected function
- Propagated time for callers: the amount of time each caller contributed to the function + descendants (F+D) time of the selected function
- The percentage of time spent in the selected function and its descendants on behalf of the caller
- A pie chart that displays the percentage of time used by each caller

For descendant functions, the Function Details window displays the following information:

- A list of immediate descendants
- The number of times the selected function called each descendant function
- Propagated time for descendants: the amount of time each descendant contributed to the function + descendants (F+D) time of the selected function
- The percentage of time each descendant contributed to the total F+D time
- A pie chart that displays the percentage of time used by each descendant

NOTE To open a new Function Details window for a descendant or caller, double-click any line in the Caller or Descendant tables.

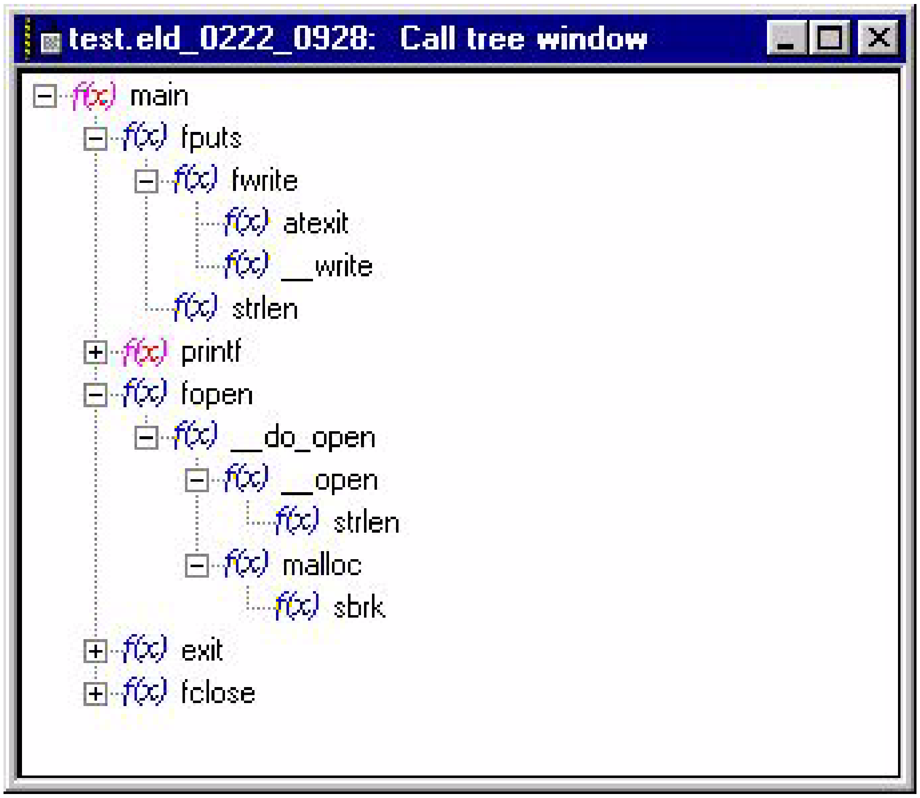
View a Function Call Tree

To view a function call tree, choose **Profiler > Function Call Tree**.

NOTE The IDE applies the Function Call Tree command to the currently selected profile in the Profiler Sessions window (indicated by a check mark next to the name of the session).

A Function Call Tree window similar to the one in Figure 10.9 appears.

Figure 10.9 The Function Call Tree Window



The Function Call Tree window shows the dynamic call structure of a program. This window also highlights the path from the most expensive function. (Red entries indicate the more expensive paths.)

NOTE You can open a Function Details window for a function by double-clicking the function name in the Function Call Tree window.

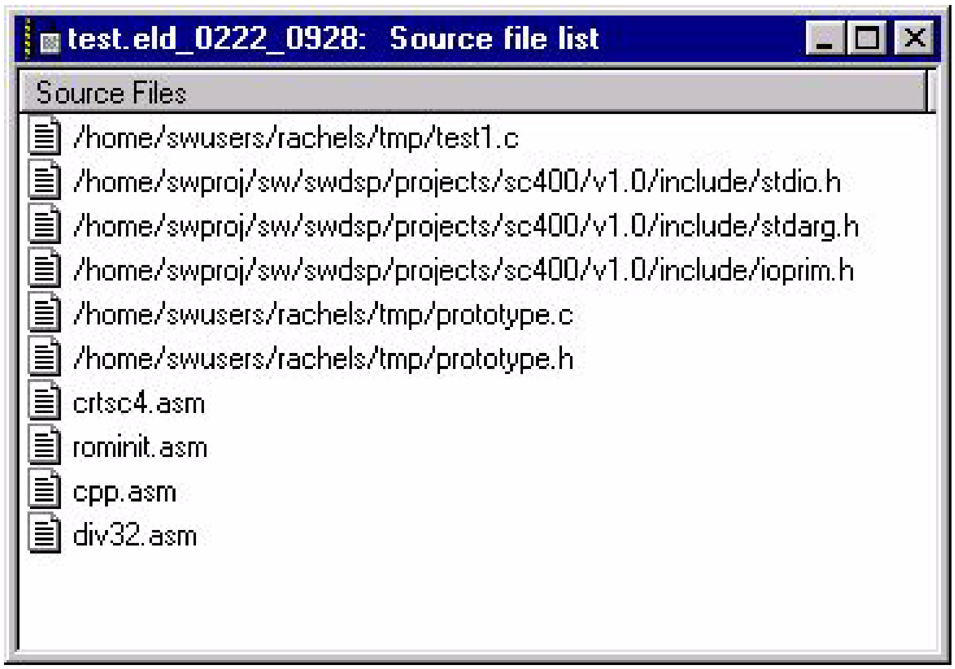
View Source Files Information

To display source files information for the current profile session, choose **Profiler > Source Files**.

NOTE The IDE applies the Source Files command to the currently selected profile in the Profiler Sessions window (indicated by a check mark next to the name of the session).

A Source Files window similar to the one in Figure 10.10 appears.

Figure 10.10 The Source Files Window



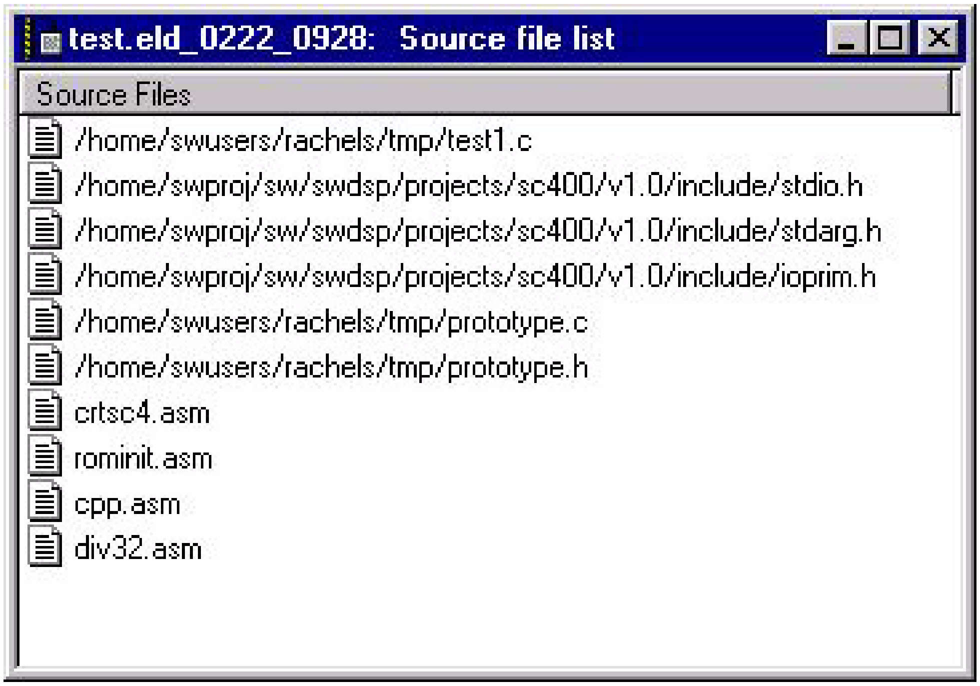
The Source Files window displays directory and file information for all files included in the current profile session.

NOTE You can view profile information line by line by double-clicking on a source file in the Source Files window.

View Profile Information Line by Line

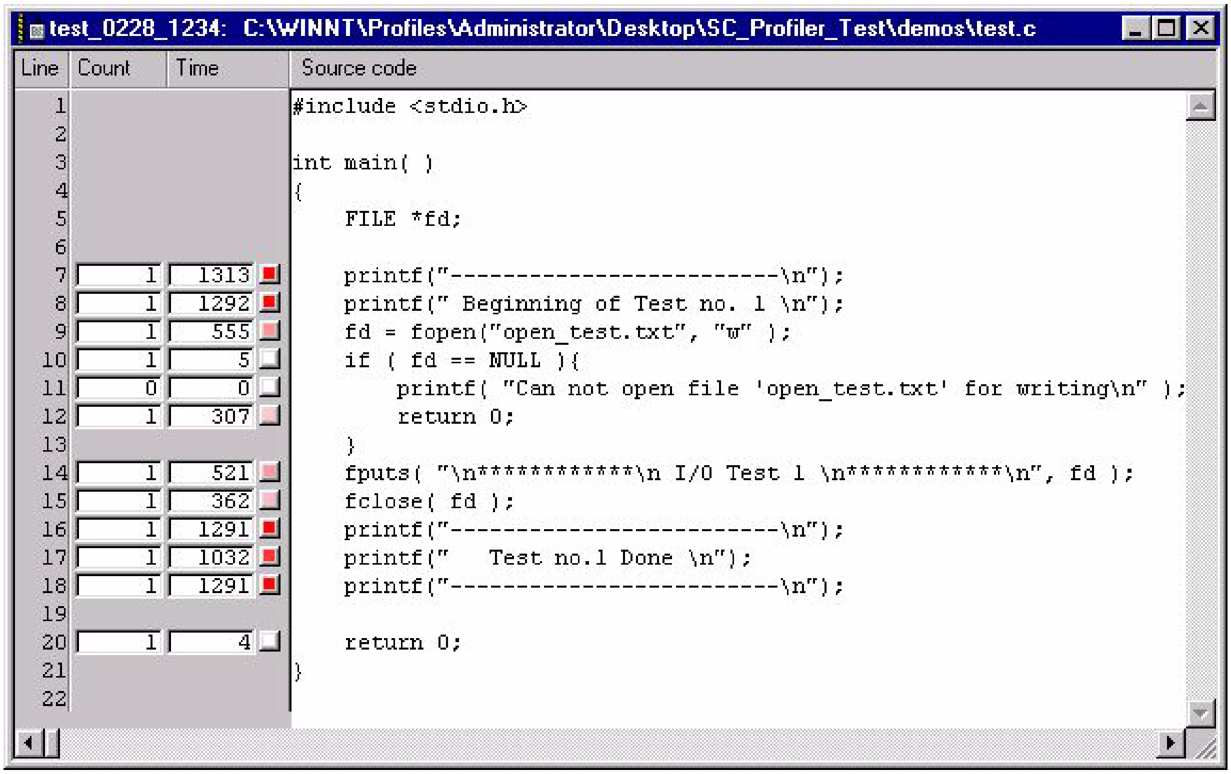
To view profile information line by line, double-click on a source file in the Source Files window. (Figure 10.11 shows an example of a Source Files window.)

Figure 10.11 The Source Files Window



A Profile Line-by-Line window appears as shown in Figure 10.12.

Figure 10.12 Profile Line-by-Line Window



For each line of source code, this window displays the number of calls made (in the Count column) and the time in instruction cycles (in the Time column).

This window also uses colored marks to indicate the most heavily used lines in the Time column. The marks range in color from white to red; the most time-consuming lines use red marks.

NOTE Examining profile information line by line is not available for assembly sources for this release.

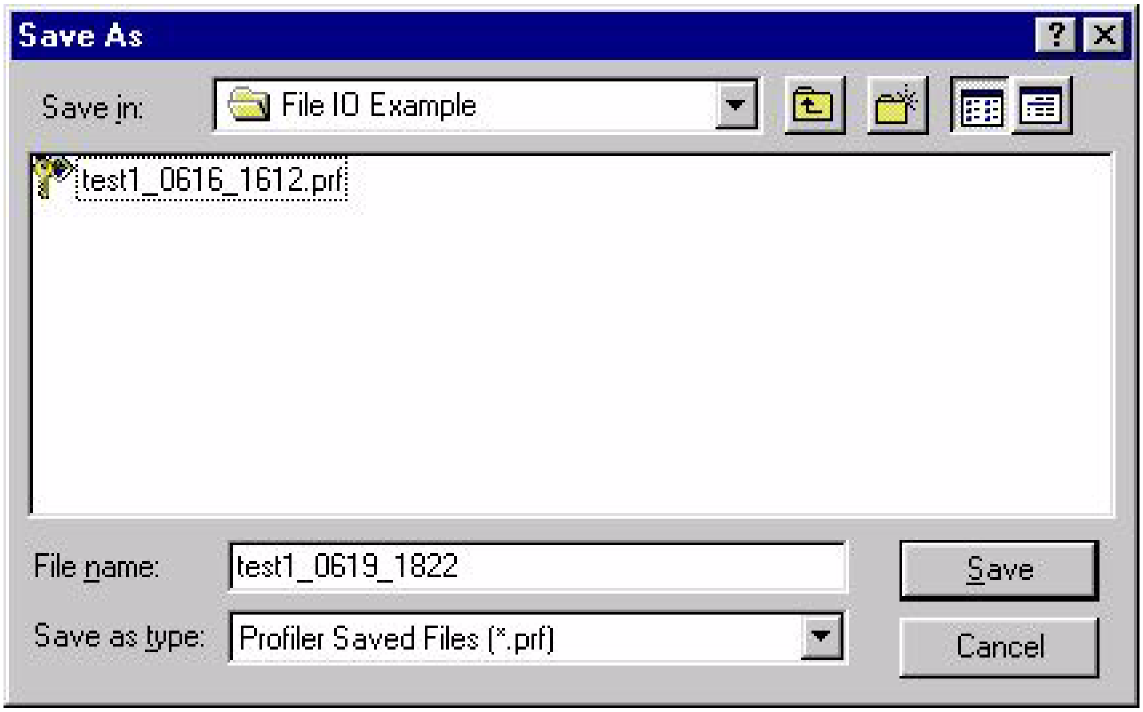
Save a Profile

To save a profile:

1 Choose **Profiler > Save**.

A Save As dialog box appears as shown in Figure 10.13.

Figure 10.13 Save As Dialog Box



2 Use the dialog box to save your file in the directory of your choice.

Load a Profile

To load a previously saved profile:

1 Choose **Profiler > Load**.

A standard dialog box appears.

2 If needed, use the dialog box to navigate to the directory that contains the profile. Otherwise, go to step 3.

3 Select the profile and click Open.

The Profiler Sessions window appears. The window contains the name of the profiler session that you specified.

4 Click on the session in the Profiler Sessions window.

5 Click Open.

The CodeWarrior IDE displays a list of functions window similar to the one shown in Figure 10.14 that contains the information for your previously saved profile.

Figure 10.14 The List of Functions Window

SC140Sim_0627_1958: List of functons

Function	Calls	F time	F+D time	% F time	% F+D time	Avg. F time	Avg. F+D time
raise	0	0	0	0.00	0.00	0	0
printf	12	252	36702	0.42	61.17	21	3058
memcpy	96	3432	3432	5.72	5.72	35	35
main	1	321	60000	0.54	100.00	321	60000
isxdigit	0	0	0	0.00	0.00	0	0
isupper	0	0	0	0.00	0.00	0	0
isspace	0	0	0	0.00	0.00	0	0
ispunct	0	0	0	0.00	0.00	0	0
isprint	0	0	0	0.00	0.00	0	0
islower	0	0	0	0.00	0.00	0	0
isgraph	0	0	0	0.00	0.00	0	0
isdigit	0	0	0	0.00	0.00	0	0
iscntrl	0	0	0	0.00	0.00	0	0
isascii	0	0	0	0.00	0.00	0	0
isalpha	0	0	0	0.00	0.00	0	0
isalnum	0	0	0	0.00	0.00	0	0
getenv	0	0	0	0.00	0.00	0	0
fwrite	60	16434	19939	27.39	33.23	273	332
fprintf	0	0	0	0.00	0.00	0	0
fill_oh_word	0	0	0	0.00	0.00	0	0
fib	12	22520	22520	37.53	37.53	1876	1876
fflush	1	412	412	0.69	0.69	412	412
fcvt	0	0	0	0.00	0.00	0	0
f_conv	0	0	0	0.00	0.00	0	0
exit	1	33	457	0.05	0.76	33	457
ecvt	0	0	0	0.00	0.00	0	0

Generate a Tab-Delimited Profiling Report

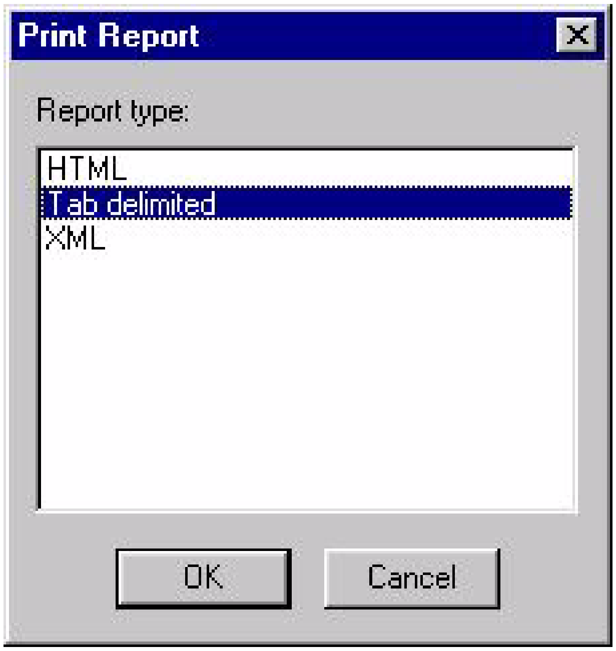
To generate a tab-delimited profiling report:

1 Choose **Profiler > Export**.

The Print Report window appears.

2 Select Tab delimited in the Print Report window as shown in Figure 10.15.

Figure 10.15 Print Report Window with Tab delimited Selected



3 Click OK.

4 Choose a location to save the file.

This tells the profiler where to place the tab-delimited output file (named `prog_report.td`). The profiler overwrites the file if it already exists.

You can open a tab-delimited report in a standard text editor or spreadsheet application. The report contains profiling information for functions as well as source code profiling by line.

Generate an HTML Profiling Report

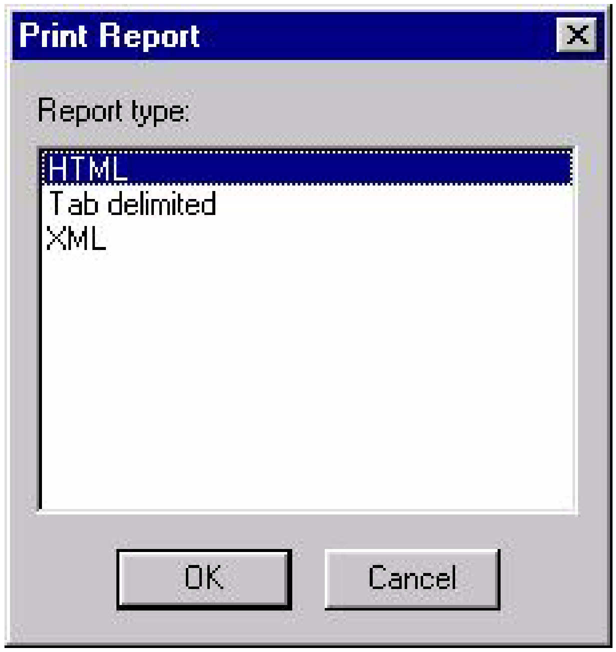
To generate a profiling report in HTML:

1 Choose **Profiler > Export**.

The Print Report window appears.

2 Select HTML in the Print Report window as shown in Figure 10.16.

Figure 10.16 Print Report Window with HTML Selected



3 Click OK.

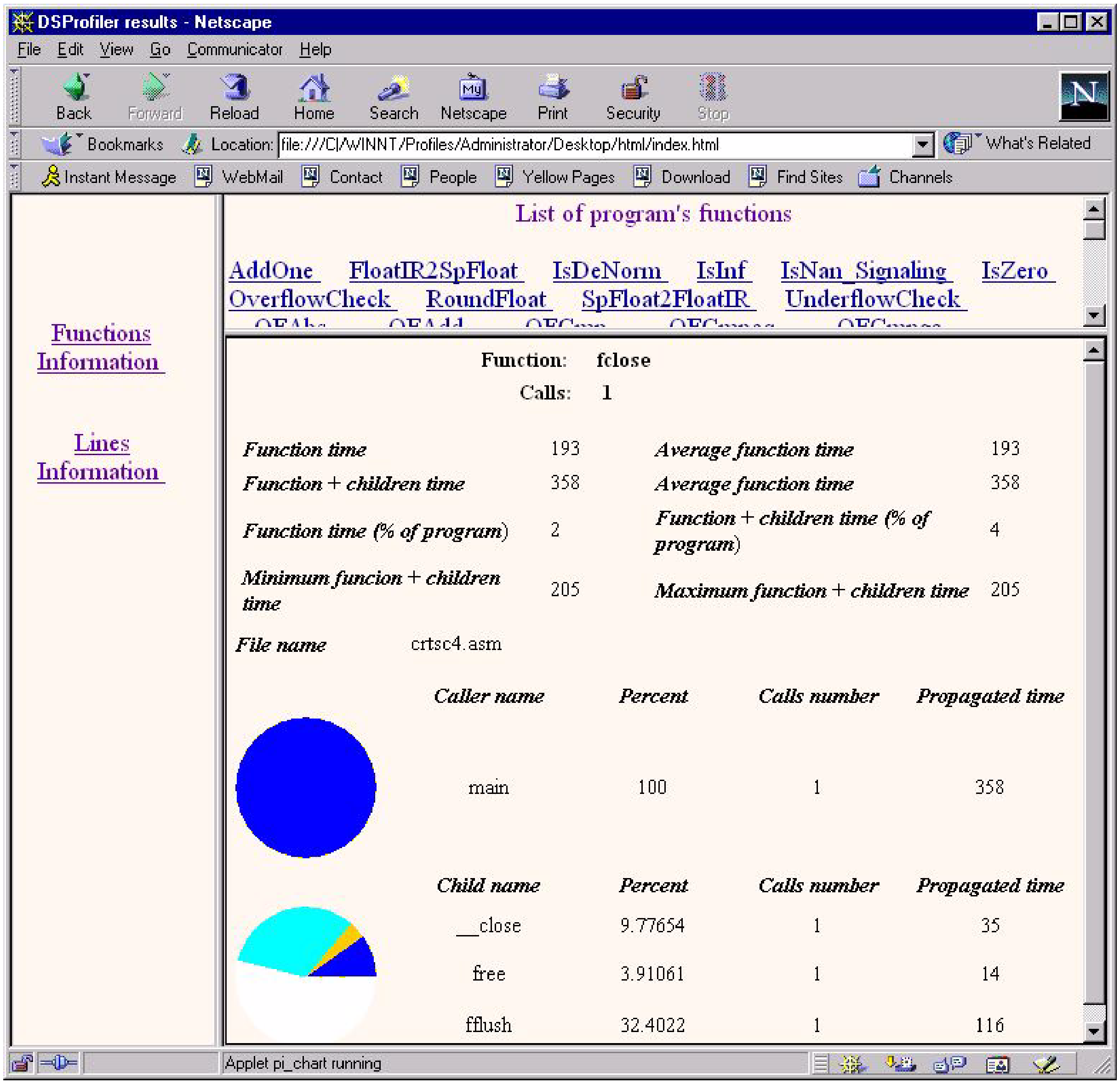
4 Choose a location to save the file.

This tells the profiler where to place the HTML output files and the java class file needed to draw charts. The profiler overwrites the HTML output files and java class file if they already exist.

5 To view the report, open `index.html` in the directory where you saved the report.

Figure 10.17 shows an example of an HTML report.

Figure 10.17 Viewing an HTML Profiling Report in a Web Browser



Generate an XML Profiling Report

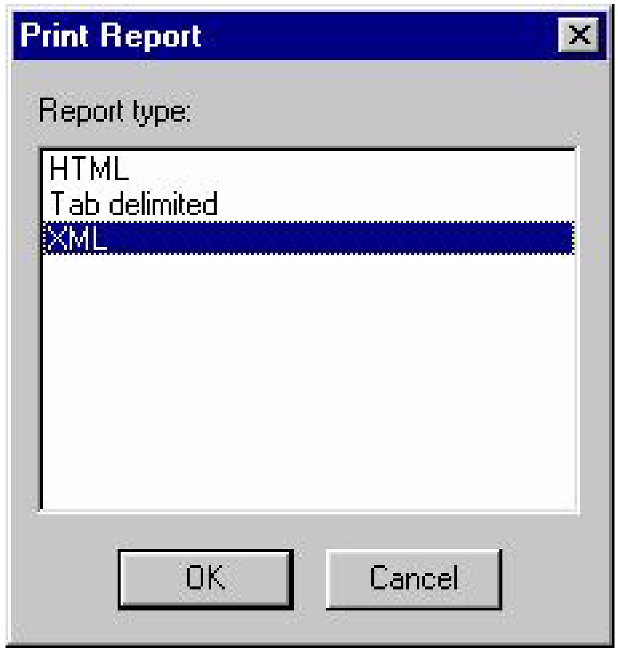
To generate a profiling report in XML:

1 Choose **Profiler > Export**.

The Print Report window appears.

2 Select XML in the Print Report window as shown in Figure 10.18.

Figure 10.18 Print Report Window with XML Selected



3 Click OK.

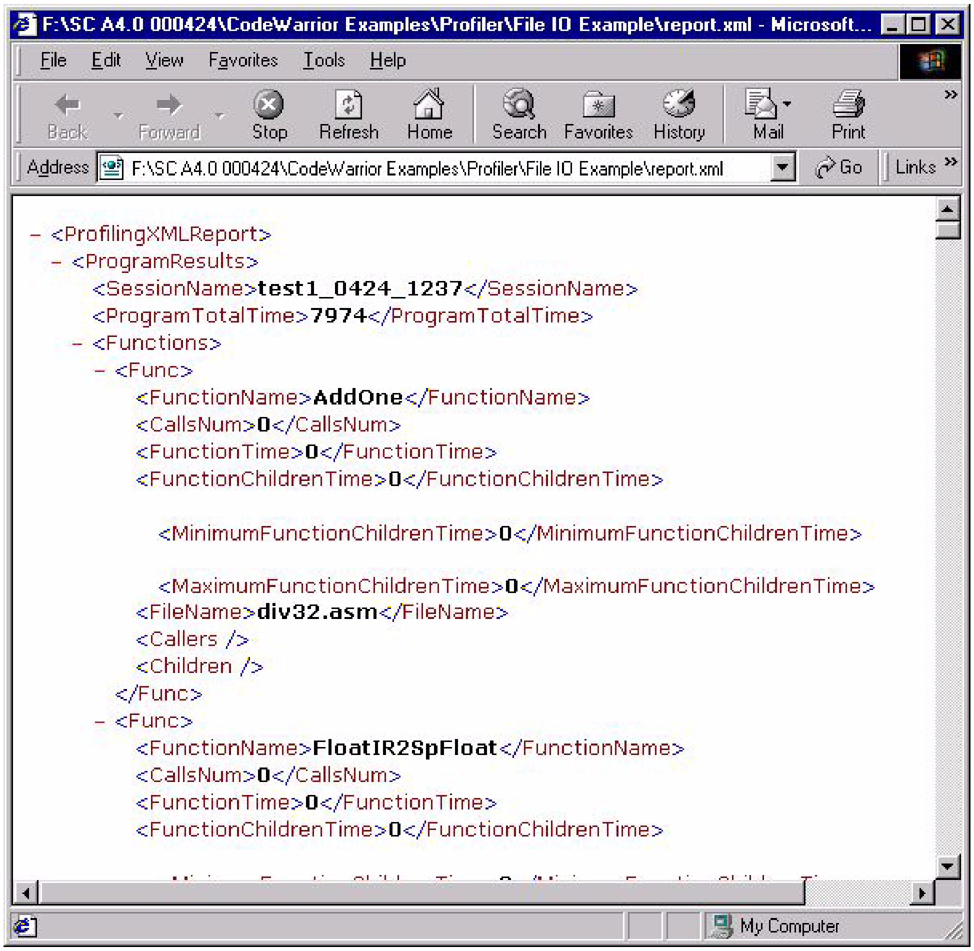
4 Choose a location to save the file.

This tells the profiler where to place the report (named `report.xml`). The report contains the XML output for the function call tree with number of calls made, function time, and time for child functions.

NOTE To view `report.xml`, you must use Internet Explorer version 5.0 or greater.

Figure 10.19 shows an example of an XML report.

Figure 10.19 Viewing an XML Profiling Report in a Web Browser



Set Up to Profile Assembly Language Programs

To get profiling results from an assembly language program:

1 Use the following syntax for assembly language functions:

```
global func_name
func_name type func

    function_source_code

Ffunc_name_end
```

2 Adhere to the following items:

- Call or jump to the subroutine by only one change-of-flow instruction.
- Provide only one entry point for the function you want to profile (the first subroutine instruction).
- Return from the subroutine by only one change-of-flow instruction.

11

Debugging Optimized Code

The CodeWarrior debugger can match the optimized final code to its original source, thereby providing source-level debugging for optimized code.

This chapter describes these features for debugging optimized code.

- Code Mapping View Window
- Run Control for Optimized Code

Code Mapping View Window

The code mapping view (CMV) window is a debugging tool that displays a side-by-side view of the disassembly of generated assembly instructions and the original source statements. It is only available if you are debugging. To access it, select **View > Code Mapping View** while debugging.

The CMV window and the debugger window are synchronized. However, the debugger window lacks certain run control and breakpoint options that the CMV provides, such as optimized code step evaluators, multiple program counter arrows, and various optimized code breakpoints.

Because of these additional features, we recommend that you debug your optimized code using the CMV window instead of the debugger window.

- Viewing the Code Mapping Window
- User Interface of the Code Mapping Window
- Analyzing Optimized Code

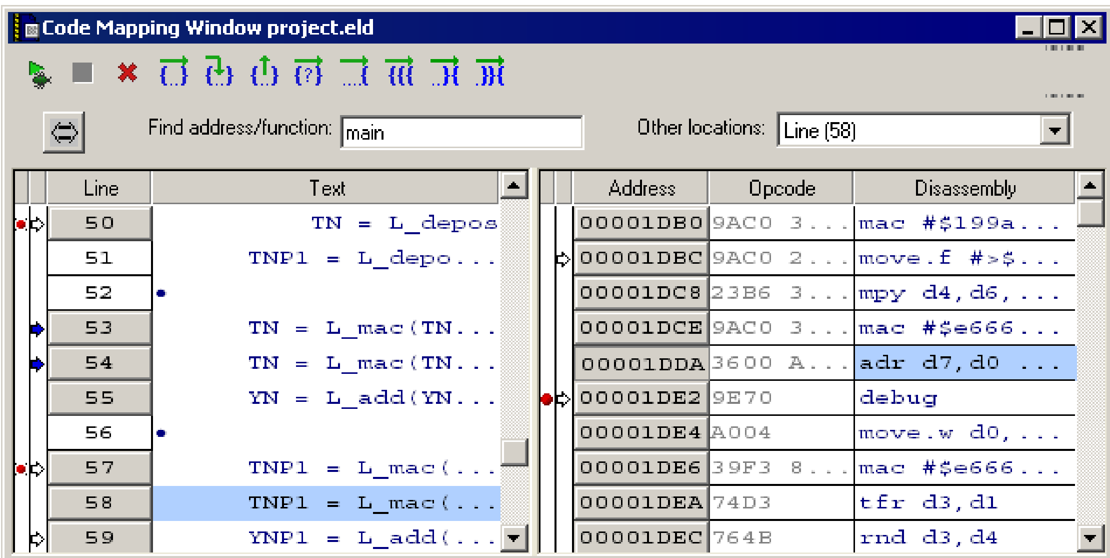
Viewing the Code Mapping Window

To begin using the Code Mapping window, follow these steps:

1. Choose **Project > Debug** to start a debugging session.
2. Choose **View > Code Mapping View**.

   The Code Mapping window appears.

Figure 11.1 Code Mapping Window



User Interface of the Code Mapping Window

The Code Mapping window contains the following user interface elements:

Expanded Step Controls

Run Control options include the standard debugger run control commands, plus expanded step controls.

Table 11.1 Expanded Step Controls

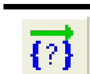
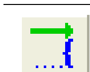
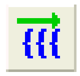
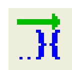
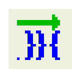
	Step Naive
	Step Next

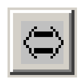
Table 11.1 Expanded Step Controls

	Step Forward
	Step After End of Statement
	Step After All Previous

Address Bar

The address bar contains these interface elements:

- Swap Panes

  The Swap Panes button  toggles between displaying source code in the right pane and displaying source code in the left pane.

- Find address/function

  Type a function name or address location to locate the corresponding side-by-side view. If you type in an address, it must be in C hexadecimal notation (for example, `0xffff`).

- Other locations

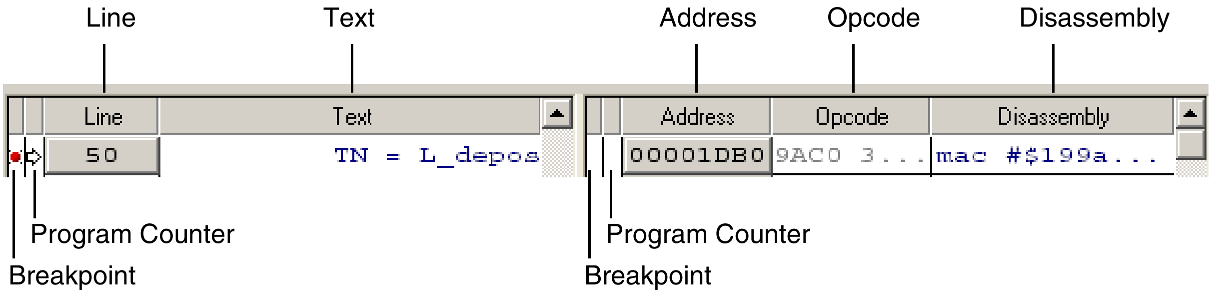
  If an address is currently selected, this list box displays the complete list of source code line numbers that correspond to the current address, if any.

  If a source code line is currently selected, this list box displays the complete list of addresses that correspond to the current source code line, if any.

Pane Controls

The source and instruction view panes (Figure 11.2) contain these interface elements:

Figure 11.2 View Pane Elements



- Breakpoint

  Displays the breakpoints associated with a line of source or assembly.

- Program Counter

  Displays the program counters associated with a line of source or assembly.

- Line

  The line number of the original source.

- Text

  The source code from the original project.

- Address

  The hexadecimal address of the generated opcode.

- Opcode

  The opcode generated from the source file. Several opcodes often correspond to each line of source code.

- Disassembly

  The disassembled instruction of the corresponding opcode.

Analyzing Optimized Code

The Code Mapping View lets you analyze optimized code in several ways:

View Corresponding Statements

Click a statement line in the source pane to highlight the corresponding disassembly in green.

Click an instruction address in the assembly pane to highlight the corresponding source instructions in blue.

The **Other Locations** list box lets you browse the complete list of corresponding statement lines or disassembly addresses.

Evaluate Run Control

Right-click a statement line to open the Evaluate Run Control drop-down menu. The options in the run control menu let you preview the results of step commands. Unlike the regular program counter ➧, the preview program counters appear as a hollow arrow ⇨.

Run Control for Optimized Code

Optimized code does not follow the same flow as your source code. To help us navigate optimized code, we use special breakpoints and step functions.

- Breakpoints
- Step Functions

Breakpoints

There are four different breakpoint that help you debug optimized code in the code mapping view.

- Break Naive
- Break Begin of Statement
- Break End of Statement
- Break After All Previous

There are also two new representations for breakpoints.

- Shadow Breakpoints
- Half-Shaded Breakpoints

Break Naive

A break naive breakpoint sets breaks on all the assembly instructions or source statements that correspond to the current line.

Break Begin of Statement

A break-begin-of-statement breakpoint sets a break on the first instruction that the compiler generated for the current statement.

Break End of Statement

A break-end-of-statement breakpoint sets a break on the first instruction that is the beginning of a source statement.

Break After All Previous

A break-after-all-previous breakpoint sets a break at a location that is free from any side effects of statements that are still executing. The OCD engine places the break at the nearest location where the current statement and all its predecessors will have completed execution.

Shadow Breakpoints

When you set a breakpoint, the debugger sometimes creates shadow breakpoints elsewhere in the source. The debugger creates shadow breakpoints in two situations:

- If you set a break on an instruction, the shadow breakpoints appear on the corresponding source statements.
- If you set a breakpoint on a statement that generates instructions that also correspond to other source statements, the shadow breakpoints appear on the corresponding source statements.

The debugger represents shadow breakpoints with the icon, a red dot with small black dots in the corners.

You can remove a shadow breakpoint by clicking it, but doing so also removes the original breakpoint and any other related shadow breakpoints. The debugger prompts you for confirmation before removing a shadow breakpoint.

Half-Shaded Breakpoints

The code mapping view lets you set breakpoints on lines that do not have an equivalent in the source pane of the debugger window. Such breakpoints are represented by the icon, a half-shaded red dot. As there are no source pane equivalents, these breakpoints will not appear in the debugger window. Half-shaded breakpoints can only be cleared from the assembly pane of the CMV window.

Step Functions

All stepping modes, especially Step After All Previous, have the potential to reach the end of the current function. If this function is `main()`, it may end the program. Using the step evaluation functions of the code mapping view can help you identify such instances.

- Step Naive
- Step Next
- Step Forward
- Step After End of Statement
- Step After All Previous

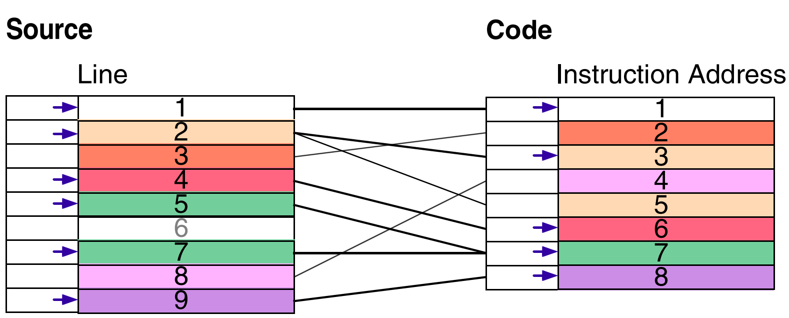
Step Naive

The Step Naive command steps to the first instruction of the next statement in the source code.

Step Next

The Step Next command steps to the next source statement whose instructions come after the current instruction.

Figure 11.3 Examples of Step Next



In the example shown in Figure 11.3, these are the reasons why the step next function stops at certain instruction addresses.

1. Execution starts at **address1**, **line1**

2.a. It passes **address2**, **line3** because **line2** has not been executed

2.b. It stops on **address3**, **line2** because **line2** is the closest line to **line1** that has not been executed.

3.a. It passes **address4**; **line8** because **lines 4-7** have not been executed

3.b. It passes **address5**; **line2**, because it already stopped at **line2**.

3.c. It stops on **address6**; **line4** because it is the closest line to **line2** that has not been executed

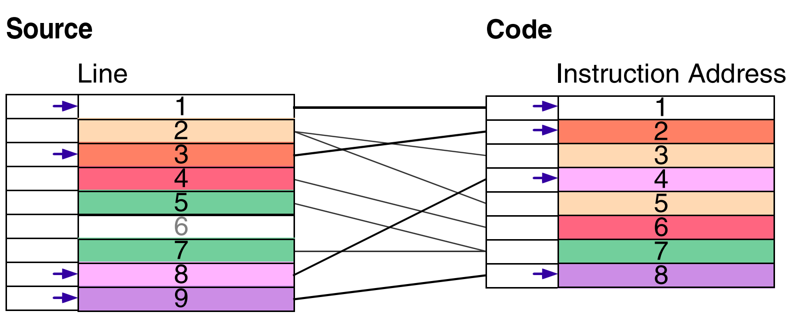
4. It stops on **address7**; **line5** and **line7** because **line5** is the closest line to **line4** that has not been executed.

5. It stops on **address8**; **line9** because it is the closest line to **line5** that has not been executed. It does not matter in this case if you stepped from **line5** or **line7** to reach this point, because **line6** was optimized out. However, it can be important in other cases. The OCD algorithm selects the lowest line number unless you specify otherwise. To specify a different line, click its number in the CMV source pane.

Step Forward

The Step Forward command steps to the next instruction address where the corresponding statement comes after the current statement.

Figure 11.4 Examples of Step Forward



In the example shown in Figure 11.4, these are the reasons why the step forward function stops at certain instruction addresses.

1. Execution starts at **address1; line1**

2. It stops on **address2**; **line3** because it is the first address of a line that follows **line1**.

3. It passes **address3**; **line2** because this line precede **line3**.

3.b. It stops on **address4**; **line8** because it is the first address of a line that follows **line3**.

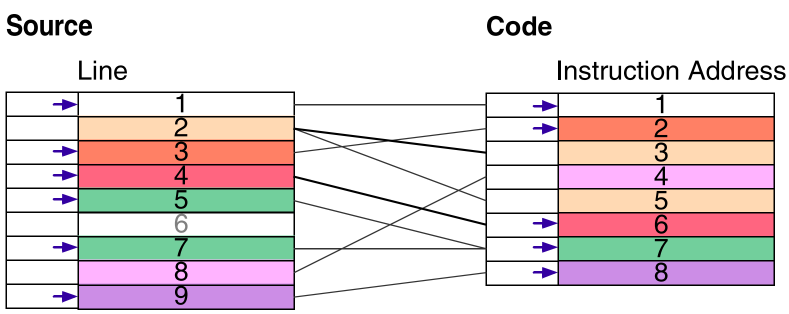
4. It passes **address5-address7** because their corresponding lines precede **line8**.

5. It stops on **address8**; **line9** because it is the first address of a line that follows **line8**.

Step After End of Statement

The Step After End of Statement command steps to the first instruction of the next source statement whose instruction has not yet been executed.

Figure 11.5 Examples of Step After End of Statement



In the example shown in Figure 11.5, these are the reasons why the step after end of statement function stops at certain instruction addresses.

1. Execution starts at address1; line1.

2. It stops on **address2**; **line3** because it is the first instruction that appears after all of **line1**'s instructions have been executed, and because **line3** succeeds **line1**.

3.a. It passes **address3-address5** because **line2** precedes **line3**, and its execution does not end until **address5**.

3.b. It stops on **address6**; **line4** because it is the first instruction that appears after all of **line3**'s instructions have been executed, and because **line4** succeeds **line3**.

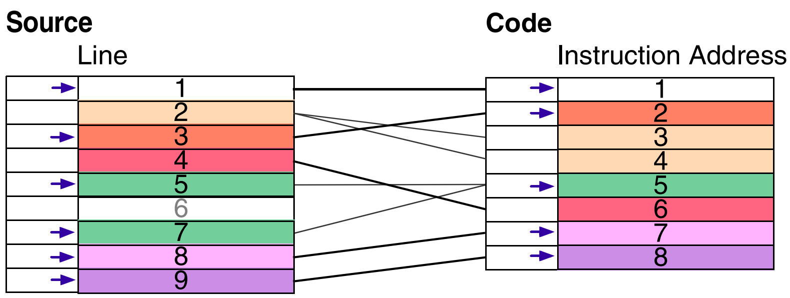
4. It stops on **address7**; **line5** and **line7** because it is the first instruction that appears after all of **line4**'s instructions are executed, and because **line5** and **line7** succeed **line4**.

5. It stops on **address8**; **line9**, because it is the first instruction that appears after all of **line5**'s instructions are executed, and because **line9** succeeds **line5**.

Step After All Previous

The Step After All Previous command steps to the next statement that is free from the side effects of instructions that are still executing.

Figure 11.6 Examples of Step After All Previous



In the example shown in Figure 11.6, these are the reasons why the step after all previous function stops at certain instruction addresses.

1. Execution starts at **address1**;**line1.**

2. It stops on **address2**; **line3** because it is the first instruction that appears after **line1** is executed, and because there are no lines that precede **line1**.

3.1 It passes **address3** and **address4** because **line2** precedes **line3**, and **line2** still has instructions that are executing.

3.2 It stops on **address5; line5** and **line7** because it is the first instruction that appears after the last instruction of **line3** is executed, and because the execution of all lines previous to **line3** is over at this point

4a. It passes **address6**; **line4** because **line4** precedes **line5**, and **line4** still has instructions that are executing.

4.b. It stops on **address7**; **line8** because it is the first instruction that appears after the last instruction of **line5** is executed, and because the execution of all lines previous to **line5** is over at this point.

5. It stops on **address8**; **line9** because it is the first instruction that appears after the last instruction of **line8** is executed, and because the execution of all lines previous to **line8** is over at this point.

12

High-Speed Simultaneous Transfer and Data Visualization

This chapter describes the methods used for High-Speed Simultaneous Transfer (HSST) and for Data Visualization.

- HSST
- Data Visualization

HSST

High-Speed Simultaneous Transfer (HSST) facilitates data transfer between low-level targets (hardware or simulator) and host-side client applications. The data transfer occurs without stopping the core. The host-side client application must be an IDE plug-in or a script run through the command-line debugger.

To use HSST, launch the target side application from the debugger. The debugger automatically enables HSST communications as required.

- Host-Side Client Interface
- Target Library Interface

Host-Side Client Interface

This section describes the API calls for using High-Speed Simultaneous Transfer (HSST) from your host-side client application.

hsst_open

A host-side client application uses this function to open a communication channel with the low-level target. Opening a channel that has already been opened will result in the same channel ID being returned.

```
HRESULT hsst_open (
    const char* channel_name,
    size_t *cid );
```

`channel_name`

This parameter specifies the communication channel name.

`cid`

This parameter specifies the channel ID associated with the communication channel.

Returns This function returns `S_OK` if the call succeeds or `S_FALSE` if the call fails.

hsst_close

A host-side client application uses this function to close a communication channel with the low-level target.

```
HRESULT hsst_close ( size_t channel_id ) ;
```

`channel_id`

This parameter specifies the channel ID of the communication channel to close.

Returns This function returns `S_OK` if the call succeeds or `S_FALSE` if the call fails.

hsst_read

A host-side client application uses this function to read data sent by the target application without stopping the core.

```
HRESULT hsst_read  (
    void *data,
    size_t size,
    size_t nmemb,
    size_t channel_id,
    size_t *read );
```

`data`

This parameter specifies the data buffer into which data is read.

`size`

This parameter specifies the size of the individual data elements to read.

`nmemb`

This parameter specifies the number of data elements to read.

`channel_id`

This parameter specifies the channel ID of the communication channel from which to read.

`read`

This parameter contains the number of data elements read.

Returns This function returns `S_OK` if the call succeeds or `S_FALSE` if the call fails.

hsst_write

A host-side client application uses this function to write data that the target application can read without stopping the core.

```
HRESULT hsst_write (
    void *data,
    size_t size,
    size_t nmemb,
    size_t channel_id,
    size_t *written );
```

`data`

This parameter specifies the data buffer that holds the data to write.

`size`

This parameter specifies the size of the individual data elements to write.

`nmemb`

This parameter specifies the number of data elements to write.

`channel_id`

This parameter specifies the channel ID of the communication channel to write to.

`written`

This parameter contains the number of data elements written.

Returns This function returns `S_OK` if the call succeeds or `S_FALSE` if the call fails.

hsst_size

A host-side client application uses this function to determine the size of unread data (in bytes) in the communication channel.

```
HRESULT hsst_size  (
    size_t channel_id,
    size_t *unread );
```

`channel_id`

This parameter specifies the channel ID of the applicable communication channel.

`unread`

This parameter contains the size of unread data in the communication channel.

Returns This function returns `S_OK` if the call succeeds or `S_FALSE` if the call fails.

hsst_block_mode

A host-side client application uses this function to set a communication channel in blocking mode. All calls to read from the specified channel block indefinitely until the requested amount of data is available. By default, a channel starts in the blocking mode.

```
HRESULT hsst_block_mode ( size_t channel_id );
```

`channel_id`

This parameter specifies the channel ID of the communication channel to set in blocking mode.

Returns This function returns `S_OK` if the call succeeds or `S_FALSE` if the call fails.

hsst_noblock_mode

A host-side client application uses this function to set a communication channel in non-blocking mode. Calls to read from the specified channel do not block for data availability.

```
HRESULT hsst_noblock_mode ( size_t channel_id );
```

`channel_id`

This parameter specifies the channel ID of the communication channel to set in non-blocking mode.

Returns This function returns `S_OK` if the call succeeds or `S_FALSE` if the call fails.

hsst_attach_listener

Use this function to attach a host-side client application as a listener to a specified communication channel. The client application receives a notification whenever data is available to read from the specified channel.

HSST notifies the client application that data is available to read from the specified channel. The client must implement this function:

```
void NotifiableHSSTClient:: Update (size_t descrip-
    tor, size_t size, size_t nmemb);
```

HSST calls the `Notifiable HSST Client:: Update` function when data is available to read.

```
HRESULT hsst_attach_listener (
    size_t cid,
    NotifiableHSSTClient *subscriber );
```

`cid`

This parameter specifies the channel ID of the communication channel to listen to.

`subscriber`

This parameter specifies the address of the variable of class `Notifiable HSST Client`.

Returns This function returns `S_OK` if the call succeeds or `S_FALSE` if the call fails.

hsst_detach_listener

Use this function to detach a host-side client application that you previously attached as a listener to the specified communication channel.

```
HRESULT hsst_detach_listener ( size_t cid );
```

`cid`

This parameter specifies the channel ID of the communication channel from which to detach a previously specified listener.

Returns This function returns `S_OK` if the call succeeds or `S_FALSE` if the call fails.

hsst_set_log_dir

A host-side client application uses this function to set a log directory for the specified communication channel.

This function allows the host-side client application to use data logged from a previous High-Speed Simultaneous Transfer (HSST) session rather than reading directly from the board.

After the initial call to `hsst_set_log_dir`, the IDE examines the specified directory for logged data associated with the relevant channel instead of communicating with the board to get the data. After all the data has been read from the file, all future reads are read from the board.

To stop reading logged data, the host-side client application calls `hsst_set_log_dir` with `NULL` as its argument. This call only affects host-side reading.

```
HRESULT hsst_set_log_dir (
    size_t cid,
    const char* log_directory );
```

`cid`

This parameter specifies the channel ID of the communication channel from which to log data.

`log_directory`

This parameter specifies the path to the directory in which to store temporary log files.

Returns This function returns `S_OK` if the call succeeds or `S_FALSE` if the call fails.

Target Library Interface

This section describes the API calls for using High-Speed Simultaneous Transfer (HSST) from your target application.

HSST_open

A target application uses this function to open a bidirectional communication channel with the host. The default setting is for the function to open an output channel in buffered mode. Opening a channel that has already been opened will result in the same channel ID being returned.

```
HSST_STREAM*  HSST_open  ( const char *stream );
```

`stream`

This parameter passes the communication channel name.

Returns This function returns the stream associated with the opened channel.

HSST_close

A target application uses this function to close a communication channel with the host.

```
int     HSST_close ( HSST_STREAM *stream );
```

`stream`

This parameter passes a pointer to the communication channel.

Returns This function returns `0` if the call was successful or `-1` if the call was unsuccessful.

HSST_setvbuf

A target application can use this function to perform the following actions:

- Set an open channel opened in write mode to use buffered mode

NOTE This can greatly improve performance.

- Resize the buffer in an existing buffered channel opened in write mode
- Provide an external buffer for an existing channel opened in write mode
- Reset buffering to unbuffered mode

You can use this function only after you successfully open the channel.

The contents of a buffer (either internal or external) at any time are indeterminate.

```
int     HSST_setvbuf (
    HSST_STREAM *rs,
    unsigned char *buf,
```

```
    int mode,
    size_t size );
```

`rs`

This parameter specifies a pointer to the communication channel.

`buf`

This parameter passes a pointer to an external buffer.

`mode`

This parameter passes the buffering mode as either buffered (specified as `HSSTFBUF`) or unbuffered (specified as `HSSTNBUF`).

`size`

This parameter passes the size of the buffer.

Returns This function returns `0` if the call was successful or `-1` if the call was unsuccessful.

HSST_write

A target application uses this function to write data for the host-side client application to read.

```
size_t   HSST_write (
    void *data,
    size_t size,
    size_t nmemb,
    HSST_STREAM *stream );
```

`data`

This parameter passes a pointer to the data buffer holding the data to write.

`size`

This parameter passes the size of the individual data elements

to write.

`nmemb`

This parameter passes the number of data elements to write.

`stream`

This parameter passes a pointer to the communication channel.

Returns This function returns the number of data elements written.

HSST_read

A target application uses this function to read data sent by the host.

```
size_t   HSST_read  (
    void *data,
    size_t size,
    size_t nmemb,
    HSST_STREAM *stream );
```

`data`

This parameter passes a pointer to the data buffer into which to read the data.

`size`

This parameter passes the size of the individual data elements to read.

`nmemb`

This parameter passes the number of data elements to read.

`stream`

This parameter passes a pointer to the communication channel.

Returns This function returns the number of data elements read.

HSST_flush

A target application uses this function to flush out data buffered in a buffered output channel.

```
int HSST_flush ( HSST_STREAM *stream );
```

`stream`

This parameter passes a pointer to the communication channel. The High-Speed Simultaneous Transfer (HSST) feature flushes all open buffered communication channels if this parameter is null.

Returns This function returns `0` if the call was successful or `-1` if the call was unsuccessful.

HSST_size

A target application uses this function to determine the size of unread data (in bytes) for the specified communication channel.

```
size_t HSST_size ( HSST_STREAM *stream );
```

`stream`

This parameter passes a pointer to the communication channel.

Returns This function returns the number of bytes of unread data.

HSST_raw_read

A target application uses this function to write raw data to a communication channel (without any automatic conversion for endianness while communicating).

```
size_t    HSST_raw_read  (
```

```
    void *ptr,
    size_t length,
    HSST_STREAM *rs );
```

`ptr`

This parameter specifies the pointer that points to the buffer into which data is read.

`length`

This parameter specifies the size of the buffer in bytes.

`rs`

This parameter specifies a pointer to the communication channel.

Returns This function returns the number of bytes of raw data read.

HSST_raw_write

A target application uses this function to read raw data from a communication channel (without any automatic conversion for endianness while communicating).

```
size_t    HSST_raw_write (
    void *ptr,
    size_t length,
    HSST_STREAM *rs );
```

`ptr`

This parameter specifies the pointer that points to the buffer that holds the data to write.

`length`

This parameter specifies the size of the buffer in bytes.

`rs`

This parameter specifies a pointer to the communication channel.

Returns This function returns the number of data elements written.

HSST_set_log_dir

A target application uses this function to set the host-side directory for storing temporary log files. Old logs that existed prior to the call to `HSST_set_log_dir()` are over-written. Logging stops when the channel is closed or when `HSST_set_log_dir()` is called with a null argument. These logs can be used by the host-side function `HSST_set_log_dir`.

```
int     HSST_set_log_dir (
    HSST_STREAM *stream,
    char *dir_name );
```

`stream`

This parameter passes a pointer to the communication channel.

`dir_name`

This parameter passes a pointer to the path to the directory in which to store temporary log files.

Returns This function returns `S_OK` if the call succeeds or `S_FALSE` if the call fails.

Data Visualization

Data visualization lets you graph variables, registers, regions of memory, and HSST data streams as they change over time. By changing the visualization filter, you can plot this data in a variety of ways, including line charts, logarithmic charts, polar coordinates, and scatter graphs.

The Data Visualization tools can plot memory data, register data, global variable data, and HSST data.

- Starting Data Visualization
- Data Target Dialog Boxes
- Graph Window Properties

Starting Data Visualization

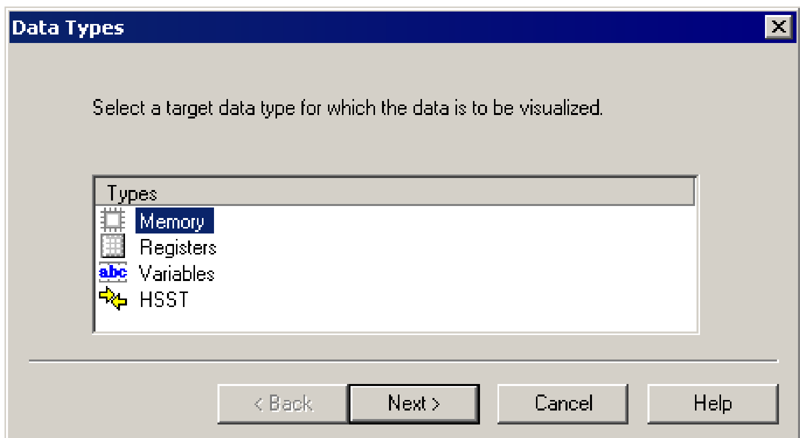
To start the Data Visualization tool:

1 Start a debug session

2 Select Data Visualization > Configurator.

The Data Types window (Figure 12.1) appears. Select a data target type and click the Next button.

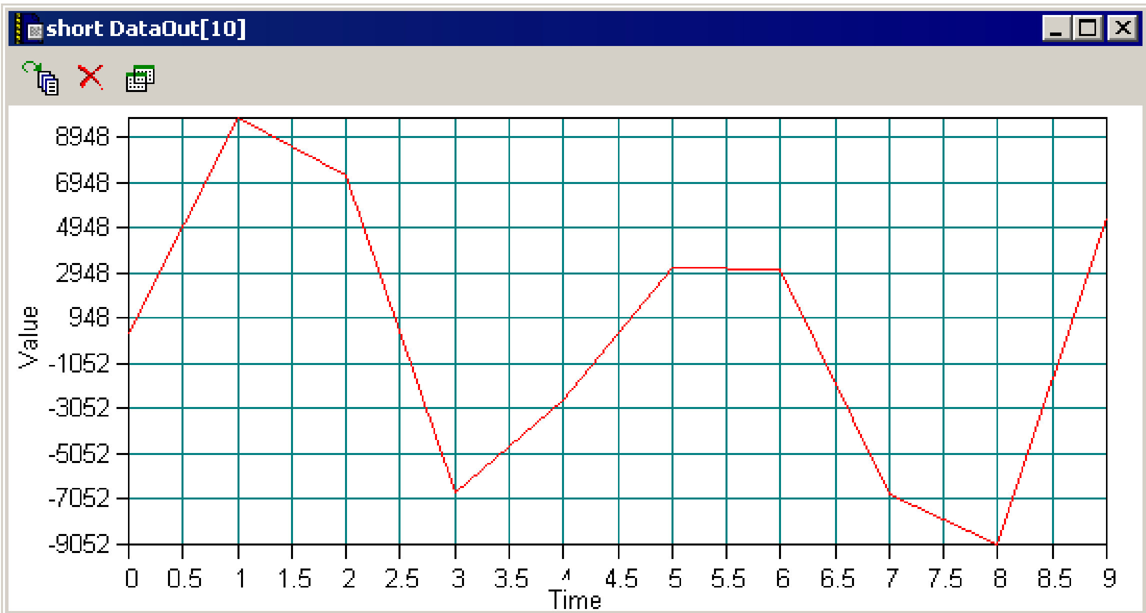
Figure 12.1 Data Types window



3 Configure the data target dialog box and filter dialog box.

4 Run your program to display the data (Figure 12.2).

Figure 12.2 Graph Window



Data Target Dialog Boxes

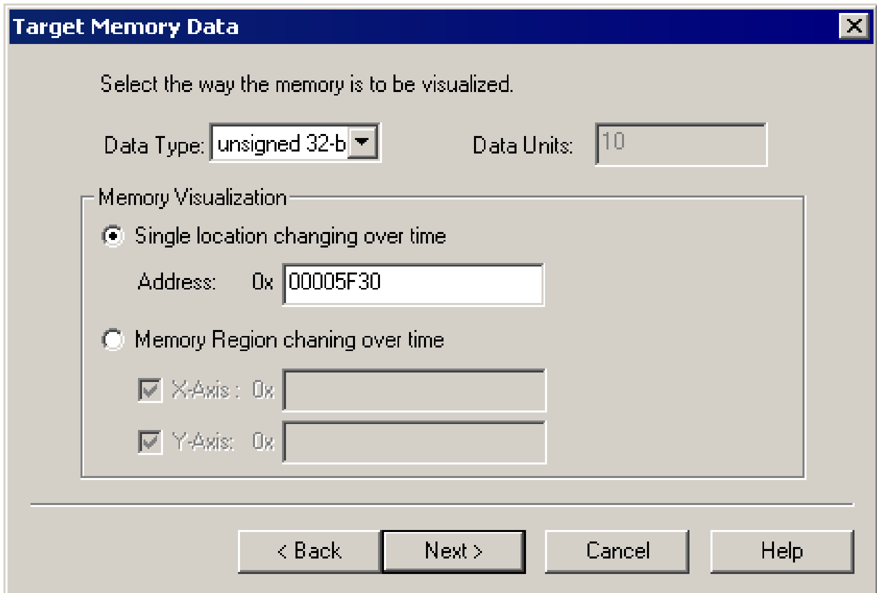
There are four possible data targets. Each target has its own configuration dialog.

- Memory
- Registers
- Variables
- HSST

Memory

The Target Memory dialog box lets you graph memory contents in real-time.

Figure 12.3 Target Memory Dialog Box



Data Type

The Data Type list box lets you select the type of data to be plotted.

Data Unit

The Data Units text field lets you enter a value for number of data units to be plotted. This option is only available when you select Memory Region Changing Over Time.

Single Location Changing Over Time

The Single Location Changing Over Time option lets you graph the value of a single memory address. Enter this memory address in the Address text field.

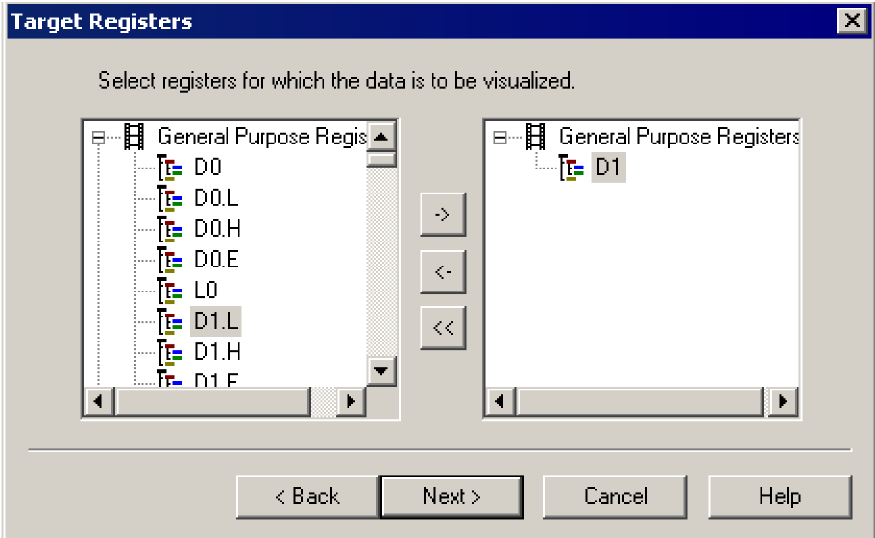
Memory Region Changing Over Time

The Memory Region Changing Over Time options lets you graph the values of a memory region. Enter the memory addresses for the region in the X-Axis and Y-Axis text fields.

Registers

The Target Registers dialog box lets you graph the value of registers in real-time.

Figure 12.4 Target Registers Dialog Box

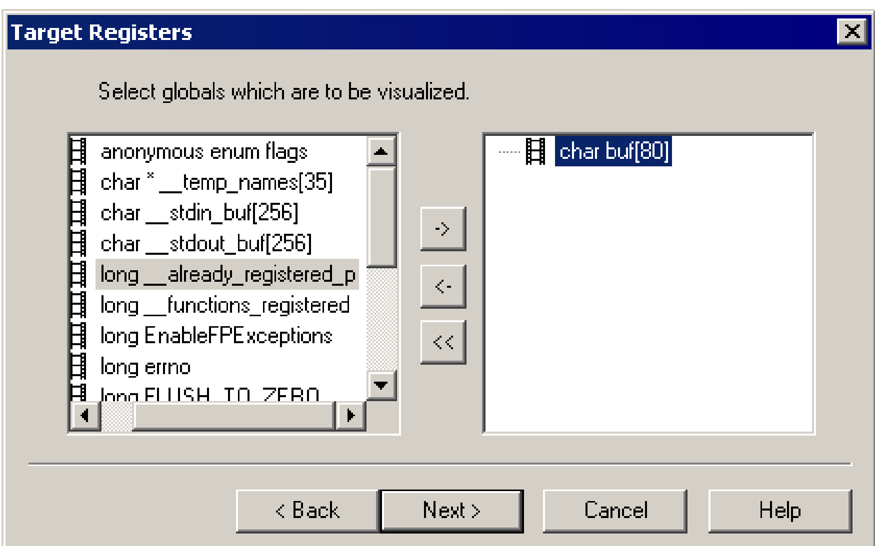


Select registers from the left column, and click the -> button to add them to the list of registers to be plotted.

Variables

The Target Variables dialog box lets you graph the value of global variables in real-time.

Figure 12.5 Target Variables Dialog Box

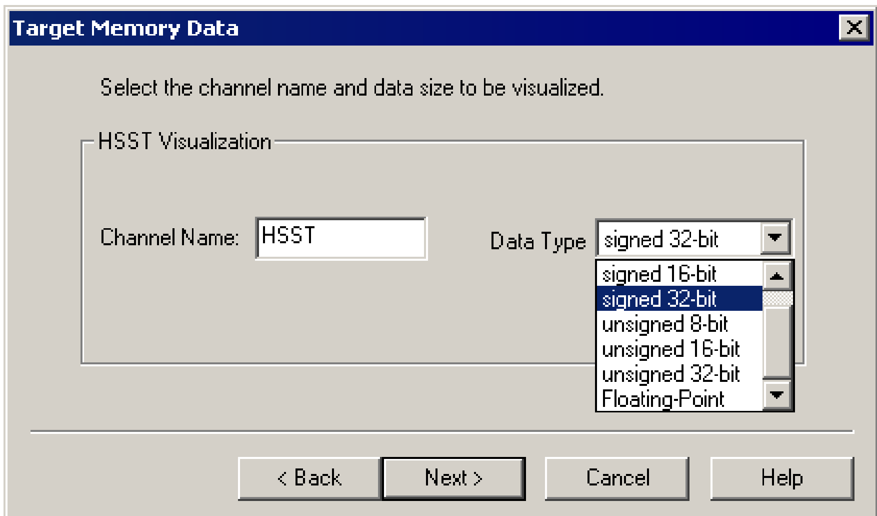


Select global registers from the left column, and click the -> button to add them to the list of variables to be plotted.

HSST

The Target HSST dialog box lets you graph the value of an HSST stream in real-time.

Figure 12.6 Target HSST Dialog Box



Channel Name

The Channel Name text field lets you specify the name of the HSST stream to be plotted.

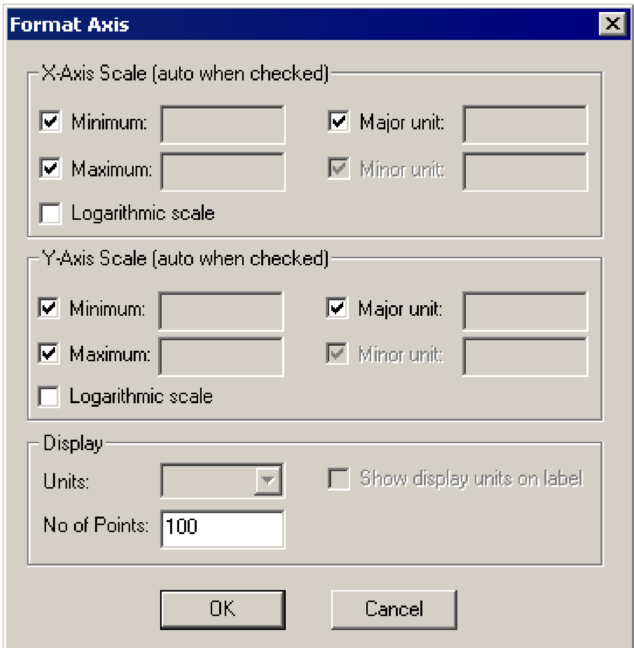
Data Type

The Data Type list box lets you select the type of data to be plotted.

Graph Window Properties

To change the look of the graph window, click the  graph properties button to open the Format Axis dialog bo.

Figure 12.7 Format Axis Dialog Box



Scaling

The default scaling settings of the data visualization tools automatically scale the graph window to fit the existing data points.

To override the automatic scaling, uncheck a scaling checkbox to enable the text field and enter your own value.

To scale either axis logarithmically, enable the Logarithmic Scale option of the corresponding axis.

Display

The Display settings let you change the maximum number of data points that are plotted on the graph.

13

Debugger Communications Protocols

The CodeWarrior debugger lets you communicate with the different targets in several ways. Table 13.1 lists the targets and the communications protocols that the IDE supports for each.

Table 13.1 Communication Protocols by Target

Target	CCS	MetroTRK	Simulator
SC140	x		
SC140 Simulator			x
MSC8101	x	x	
MSC8102	x		
MSC8102 Simulator			x

This chapter describes the following communications protocols.

- Command Converter Server
- Metrowerks Target Resident Kernel
- Simulator

Command Converter Server

The command converter server (CCS) provides a TCP/IP connection point for debugger communications. Running a CCS on your host computer lets you share access to your target board with remote users of the CodeWarrior debugger. Conversely, you have access to the target board of any remote computer running a CCS, provided that you know its IP address and CCS port number.

- Creating an IDE Remote Connection for CCS

- Running CCS
- The CCS Console
- Configuring a CCS Connection

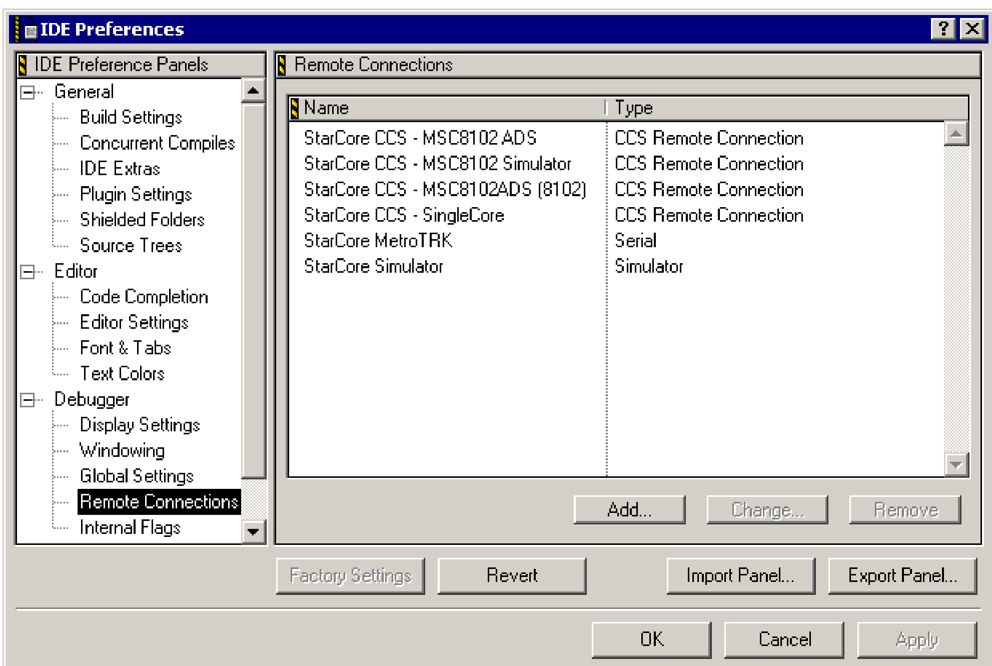
Creating an IDE Remote Connection for CCS

Before you can debug programs using CCS, you must have a remote connection for CCS in the CodeWarrior IDE. The CodeWarrior installer creates several CCS remote connections that you may edit as necessary. Or, if you do not wish to change the default connections, you may add a new remote connection.

To add a new remote connection:

1 Select **Edit > Preferences** from the IDE main menu. The IDE Preferences window (Figure 13.1) appears.

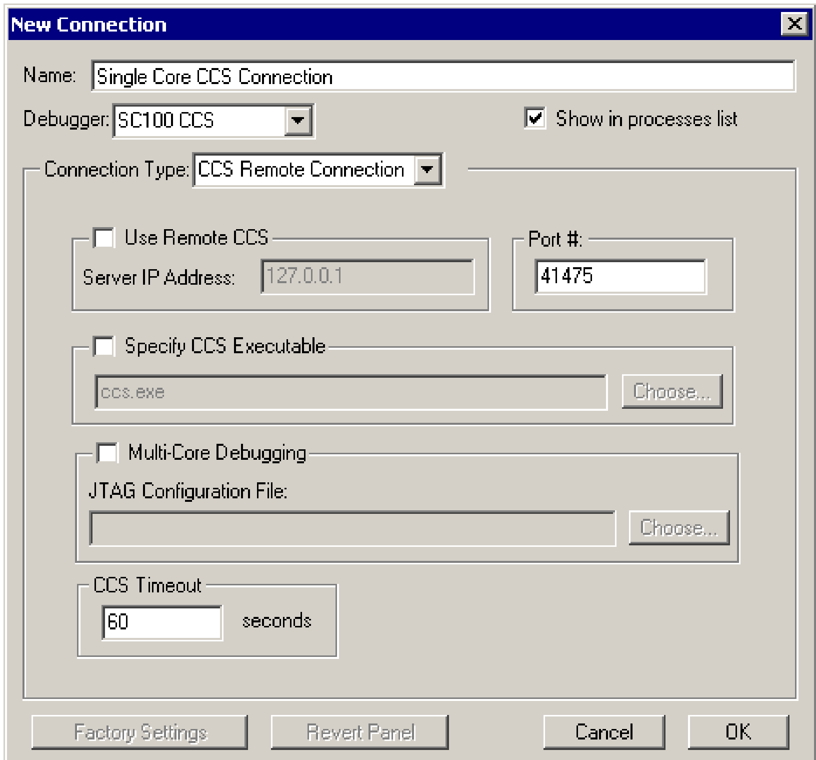
Figure 13.1 IDE Preferences window



2 Select Remote Connections from the left-side list. The Remote Connections preference panel appears.

3 Click Add. The new connection dialog appears.

Figure 13.2 New Connection dialog



4 Name the new connection in the **Name** text box.

5 Change the **Debugger** selection to **SC100 CCS**.

6 Change the **Connection Type** selection to **CCS Remote Connection**.

7 Change the **Port** setting to the CCS listen port. If you are not sure of the port, try the CCS default listen port, 41475.

8 If you are connecting to a CCS running on a different machine, enable the **Use Remote CCS** option and specify its IP address.

9 If the CCS is connected to a multi-core target such as the MSC8102, enable the **Multi-Core Debugging** option and specify its JTAG configuration file.

Running CCS

The CodeWarrior IDE automatically runs the CCS if the IDE determines that CCS is not loaded when you try to debug using a local CCS connection. If you wish to run the executable yourself, it is located in:

```
CodeWarrior\ccs\bin\ccs.exe
```

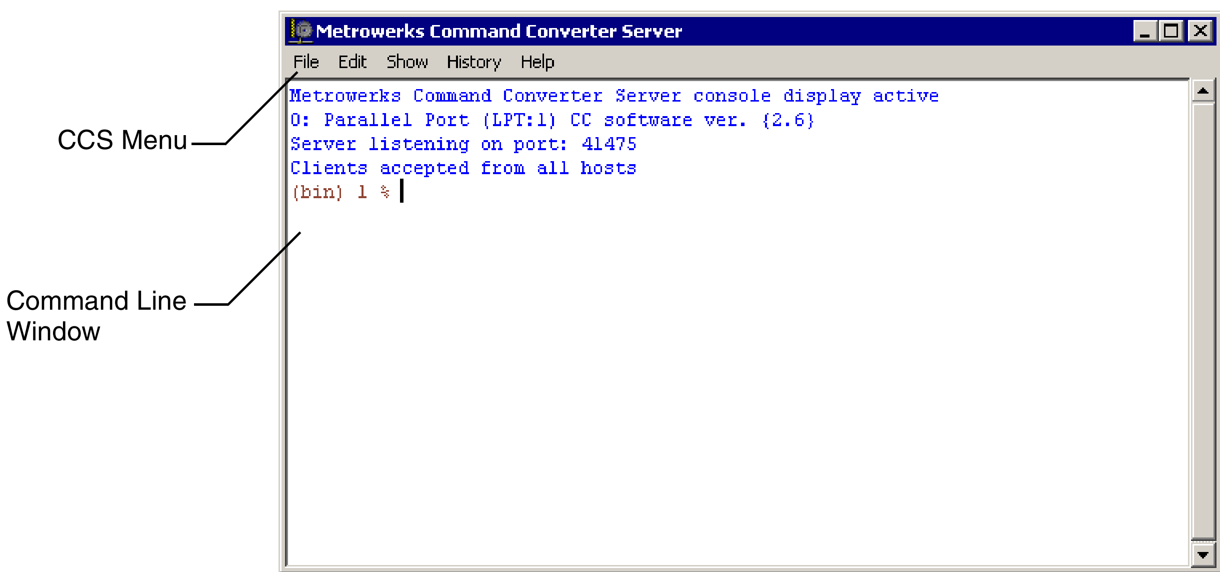
The CCS icon  appears in the Windows taskbar when the executable is running. You can right-click the icon to access the CCS pop-up menu:

- Configure - opens the CCS configuration options dialog box
- Show Console - displays the CCS console
- Hide console - hides the CCS console from view
- About CCS - displays version information
- Quit CCS - terminates CCS.

The CCS Console

The CCS console (Figure 13.3) lets you view and change the server connection options. You may issue commands by typing commands into the command line window, or by selecting options from the CCS menu.

Figure 13.3 The Command Converter Server Console

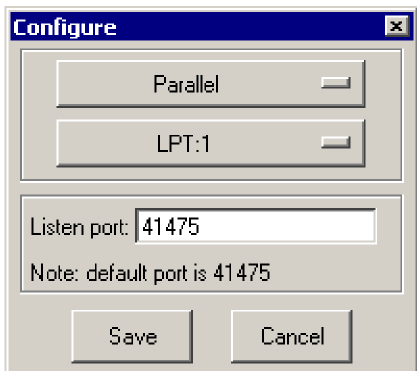


Configuring a CCS Connection

CCS is initially configured according to the options you specified during the installation procedure. You can change the properties of the connection between the host computer and the target from either the menu or the command line.

To configure the connection from the menu, open the Configure dialog (Figure 13.4), **File > Configure**.

Figure 13.4 CCS Configure dialog box



To configure the connection from the command line, use the config command to set the listen port and command converter. Before doing this, you may have to delete the existing configuration with the `delete all` command.

- Server listen port

  `config port 41475`

- Parallel port LPT1 JTAG command converter

  `config cc lpt:1`

- HTI command converter

  `config cc hti:10.1.0.1`

Metrowerks Target Resident Kernel

The Metrowerks Target Resident Kernel is a debug protocol for the MSC8101 board that allows run control through a serial connection from the host computer to the target board. MetroTRK is provided as an S-record file to be flashed to the MSC8101 board.

- MetroTRK Limitations and Restrictions
- Downloading MetroTRK to the MSC8101 Board
- Remote Debugger Settings for MetroTRK

MetroTRK Limitations and Restrictions

The MetroTRK protocol has some limitations compared to the CCS protocol.

- The MetroTRK protocol does not support HSST.
- The MetroTRK protocol cannot be used to program the flash.
- The MetroTRK protocol always loads the Memory Window in increments of 64 bytes regardless of the word size you select. However, you can still view and modify the Memory Window in any of the selectable word sizes.
- Using the profiler with the MetroTRK protocol significantly slows down debugging.
- The MetroTRK protocol does not support multi-core debugging.

There are several restrictions regarding the type of programs that MetroTRK can debug.

- The user program should not modify the memory used by MetroTRK.
- The interrupt vectors used by MetroTRK should not be accessed by the user program.
- The user program should not execute the instructions that change the status of the core such as: halt,stop,wait,debug. However, a TRAP instruction can be used to stop the core.
- The user program must not execute an initialization file. MetroTRK for the MSC8101 requires its own initialization.
- The user program should not change the clock configuration, including the pctl0 and pctl1 registers of core.

If the user program needs to use other SIC interrupts such as SCC interrupts, the user program must save the original interrupt vector and insure that the SMC interrupt is routed to the original interrupt handler.

Downloading MetroTRK to the MSC8101 Board

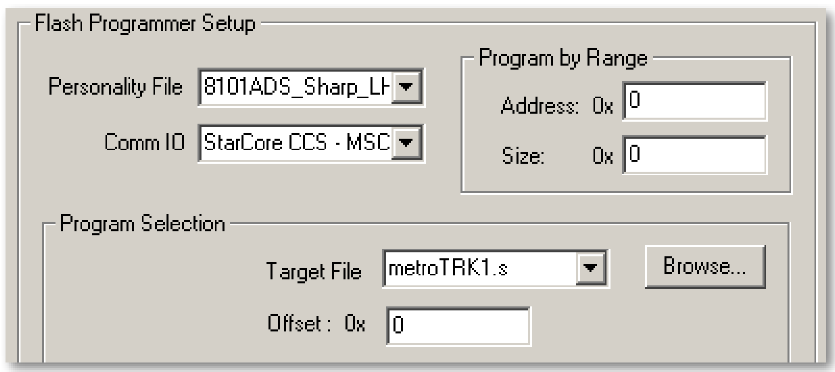
You may select from two MetroTRK S-record files. They are located in `StarCore_Tools\MetroTRK\S_Records`

- ROM1_Version\metroTRK1.s - smaller RAM footprint, slower speed
- ROM2_Version\metroTRK2.s - larger RAM footprint, faster speed

ROM1_Version\metroTRK1.s

The .text segment of this S-record file resides in flash memory. It uses less RAM than metroTRK2.s, but supports a lower maximum communications speed. To load this S-record file:

1 Program the flash with "metroTRK1.s" at offset 0x0.



2 Disconnect power from the board.

3 Disconnect from the JTAG and connect to the upper serial port RS232 (-2).

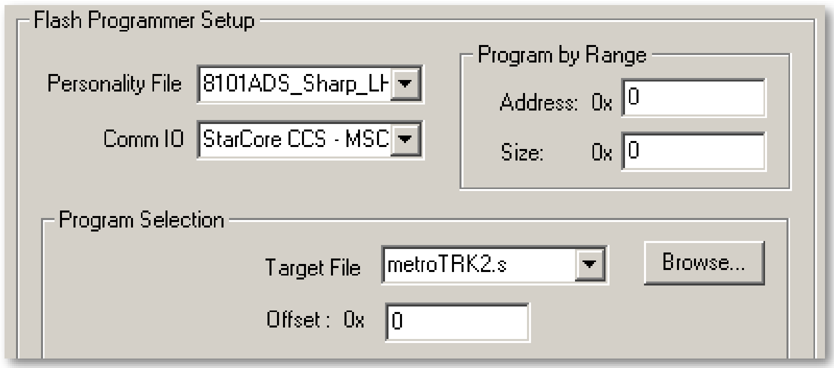
4 Set Switch 10-1 to OFF and Switch 9-7 to ON

5 Connect power to the board. LD11 and LD17 should be lit.

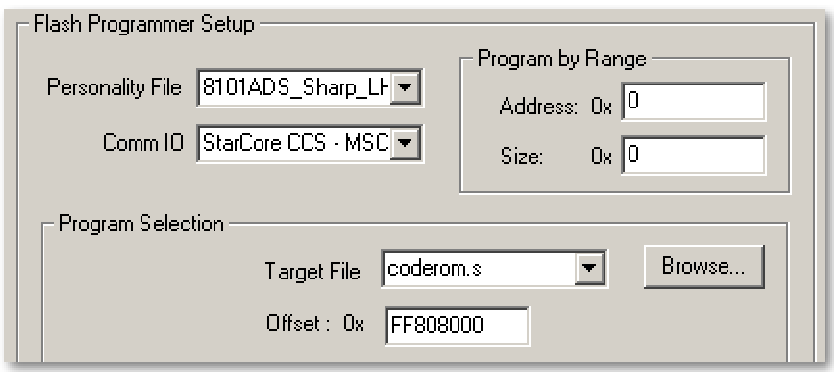
ROM2_Version\metroTRK2.s

The .text segment of this S-record file resides in SRAM. It uses more RAM than metroTRK1.s, but supports a faster communications speed. To load this S-record file:

1. Program the flash with "metroTRK2.s" at offset 0x0.



2. Program the flash with "coderom.s" at offset 0xFF808000.



3. Disconnect power from the board.

4. Disconnect from the JTAG and connect to the upper serial port RS232 (-2).

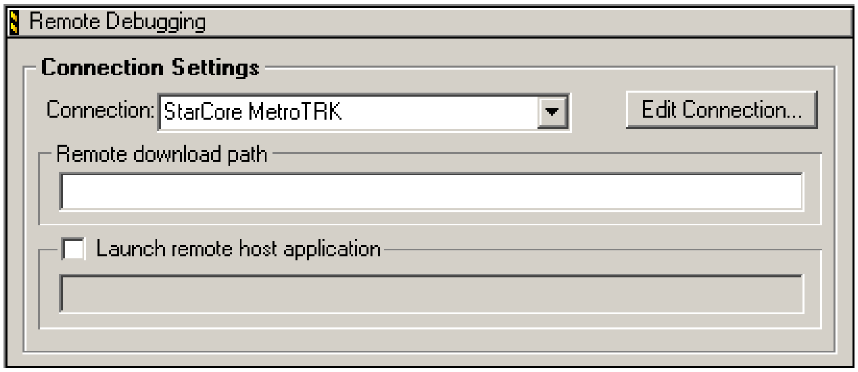
5. Set Switch 10-1 to OFF and Switch 9-7 to ON

6. Connect power to the board. LD11 and LD17 should be lit.

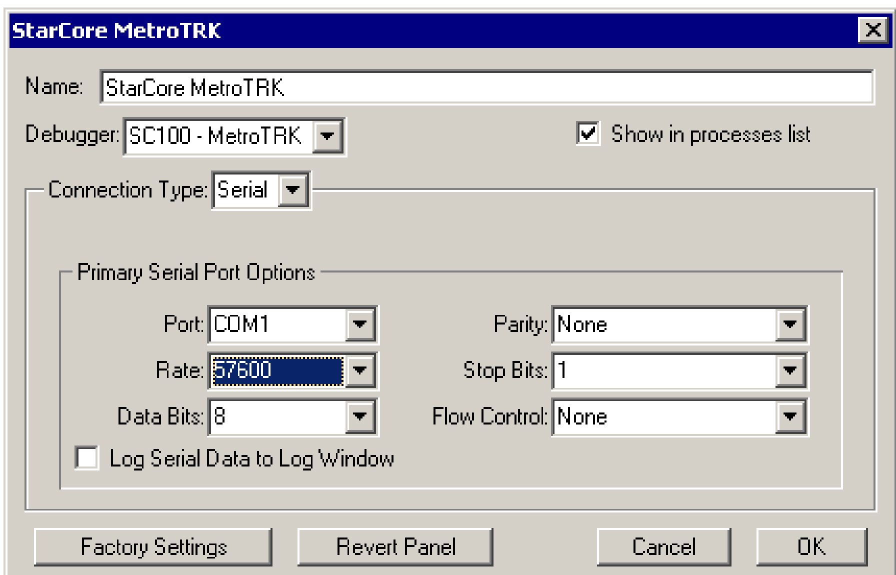
Remote Debugger Settings for MetroTRK

To use MetroTRK as the debugger protocol, you must create a remote debugger setting for it.

1 In the Target Settings Panel, Navigate to Debugger->Remote Debugging. Check "Enable Remote Debugging", and select the "StarCore MetroTRK" Connection.

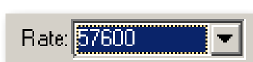


2 On the Remote Debugging Panel, press the "Edit Connection" button. The "StarCore MetroTRK" Panel appears.

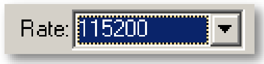


3 On the "StarCore MetroTRK" Panel:

- set Rate to 57600 if you are running metroTRK1.s



- set Rate to 115200 if you are running metroTRK2.s.



4 You can now Debug or Run the project using the MetroTRK Protocol Connection.

Simulator

In the absence of a hardware target, you can debug to either the SC100 or the MSC8102 simulator. The CodeWarrior IDE ships with two preconfigured remote connections for these simulators.

- MSC8102 Simulator
- SC100 Simulator

MSC8102 Simulator

The MSC8102 simulator simulates the multicore environment of the MSC8102 ADS board. If using the MSC8102 simulator as the target (Figure 13.5), the CCS options as defined in the remote connection (Figure 13.6) are ignored in favor of hardcoded values. The hardcoded values run CCS Sim (the simulator version of CCS) at port 41476.

Figure 13.5 SC100 Debugger Target for MSC8102 Simulator

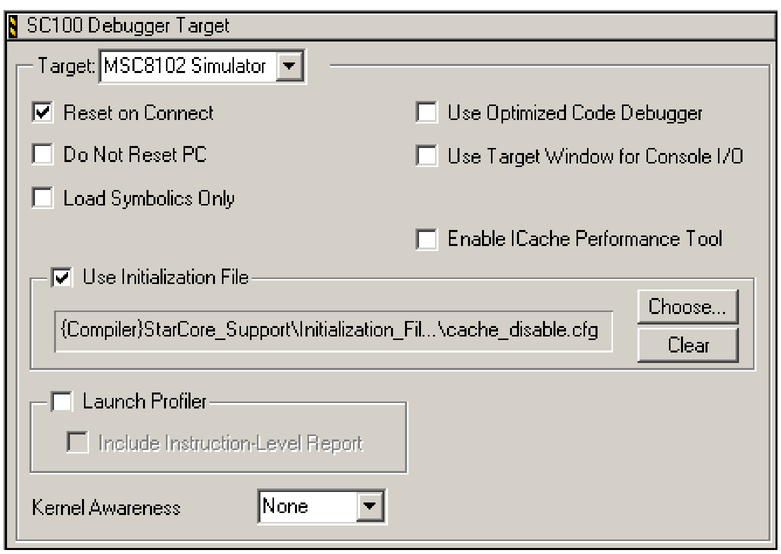
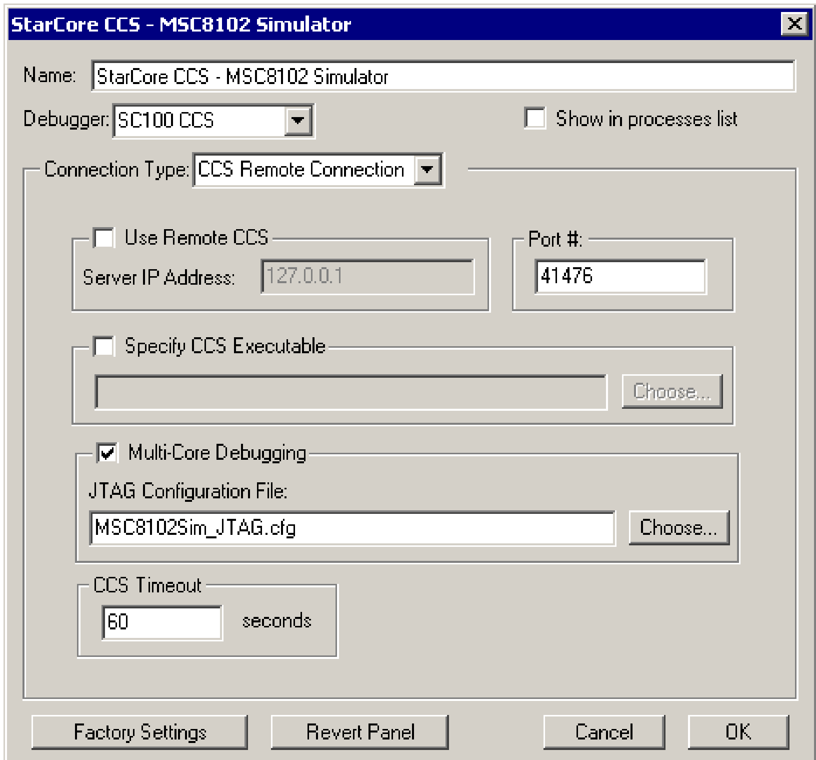


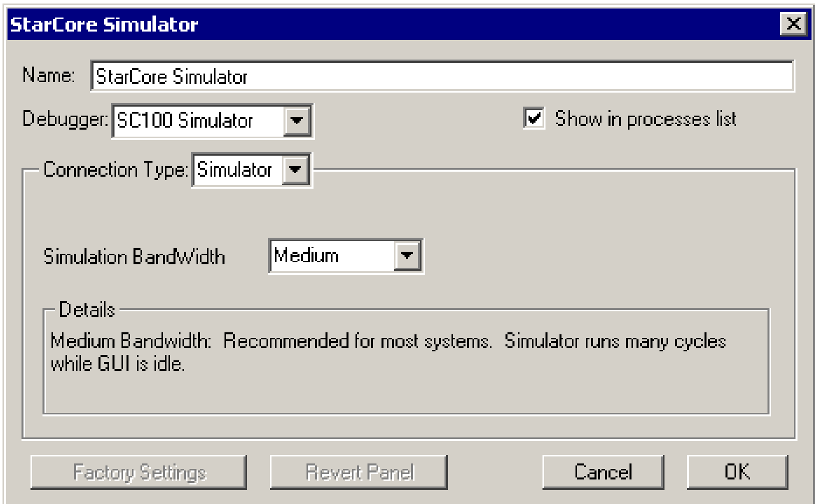
Figure 13.6 Remote Connection for MSC8102 Simulator



SC100 Simulator

The SC100 simulator simulates a single core SC100. The remote connection setting (Figure 13.7) lets you change the CPU priority of the simulator.

Figure 13.7 Remote Connection for SC100 Simulator



14

StarCore DSP Utilities

This chapter describes the following StarCore DSP-specific utilities:

- Flash Programmer
- ELF/DWARF File Dump Utility
- ELF to S-Record File Conversion Utility
- SC100-stat Utility

Flash Programmer

The integrated CodeWarrior flash programmer runs as a CodeWarrior plug-in. The application provides common flash programmer features such as:

- Program
- Erase
- BlankCheck
- Verify
- Checksum

The CodeWarrior flash programmer uses the CodeWarrior Debugger Protocol API to communicate with the target boards. The CodeWarrior flash programmer can program the flash memory of the target board with code from any CodeWarrior IDE project or from any individual executable files.

The CodeWarrior flash programmer lets you use the same IDE to program the flash of any of the embedded target boards described in "Board Support" on page 274.

This section describes the flash programmer utility:

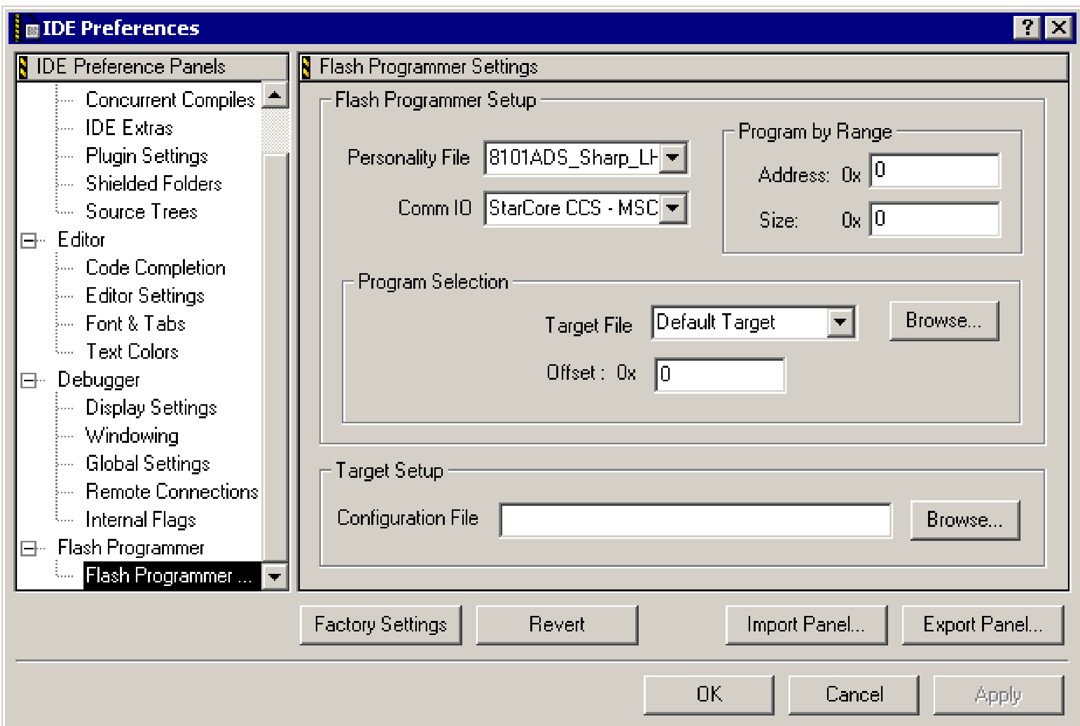
- CodeWarrior Flash Programmer Settings Panel
- Main Operations of the Flash Programmer
- Board Support

- [Modifying the Flash Programmer to Support Custom Flash Modules]
- [Personality File]

CodeWarrior Flash Programmer Settings Panel

The **Flash Programmer Settings** IDE preferences panel (Figure 14.1) lets you configure the Flash Programmer. To access this panel, select **Edit > Preferences** from the main menu bar.

Figure 14.1 Flash Programmer Settings IDE Preferences Panel



This panel contains the settings as shown in Table 14.1:

Table 14.1 Flash Programmer settings

Setting	Description	Guidance
Personality File	Sets personality file for flash memory.	Personality files for the 8012ADS and 8101ADS reference boards are located in: `CodeWarrior\Bin\Plugins\Flash_Programmer\PFE`
Comm I/O	Sets Remote Connection to be used for communicating with the target board	The IDE defines the Remote Connections in the IDE Preference Panels.
Target File	Sets the s-record file to be flashed.	The file must be an s-record file.
Offset	Sets the offset in bytes that the s-record is shifted in ROM relative to the memory addresses as defined in the s-record.	The offset must be a hexadecimal value.
Configuration File	Sets the configuration file used to initialize the target board.	Configuration files for StarCore reference boards are located in: `CodeWarrior\StarCore_Support\Initialization_Files`
Address	Sets the start address of the ROM address that the flash programmer can write to.	Use this setting to selectively replace portions of flash memory. A value of zero disables this setting.
Size	Sets the size of the memory area that the flash programmer can write to.	Use this setting to selectively replace portions of flash memory. A value of zero disables this setting.

Main Operations of the Flash Programmer

The **Flash Programmer** menu has the following commands:

- Connect
- Program
- Erase
- Blank Check
- Verify

- Checksum
- Disconnect

NOTE To enable all of the flash programmer's operations except **Connect**, you must first connect to the target by selecting **Flash Programmer>Connect**.

Connect

If you select **Flash Programmer>Connect**, the flash programmer connects to the target board.

Program

If you select **Flash Programmer>Program**:

- The flash programmer gets the filename of the file to be programmed. This file could be an executable S-Record format file that the CodeWarrior linker generates from the current project or it could be any S-Record file on your computer disk.
- The flash programmer opens a status window to display the status of this operation.
- The flash programmer gets the preference data from the **Flash Engine** panel.
- The flash programmer is programmed with the selected S-Record, depending on which setting you have selected in the personality file (for more details, see the section: "Personality File" on page 288). If in the personality file, you specify to erase sectors during the program operation, then the flash programmer erases those sectors that need to be erased so that you can flash the S-Record.
- The flash programmer reports any errors.
- The flash programmer closes the status window.

Erase

If you select **Flash Programmer>Erase**:

- The flash programmer opens a status window to display the status of the erase operation.
- The flash programmer creates a dialog box and asks you which blocks/sectors of the flash to erase as you have a choice to erase one or more blocks at a time.

- The flash programmer gets the preference data from the **Flash Programmer Settings** panel.
- The flash programmer erases selected blocks and reports any errors from the Flash Engine Module (FEM).
- The flash programmer closes the status window.

Blank Check

If you select **Flash Programmer>Blank Check**:

- The flash programmer opens a status window to display the status of the blank check operation.
- The flash programmer creates a dialog box to ask you which blocks/sectors of the flash that you want to blank check.
- The flash programmer gets the Preference Data from the **Flash Engine** panel.
- The flash programmer checks if the contents of selected blocks equal the blank value 0xFFFFFFFF and if there are any errors reports them.
- The flash programmer closes the status window.

Verify

If you select **Flash Programmer>Verify**:

- The flash programmer gets the filename of the file to be verified. This file could be the executable file that the CodeWarrior linker generates from the current project, or it could be any file in your computer disk as selected in the flash programmer main dialog box.
- The flash programmer opens the status window to display the status while performing the comparison.
- The flash programmer uploads the data from the target board and compares the data from the target board with the data from the S-Record.
- If the data from the target board does not match the data from the buffers, the flash programmer reports the discrepancy.
- The flash programmer closes the status window.

Checksum

If you select **Flash Programmer>Checksum**:

- The flash programmer opens a status window to display status of the checksum operation.
- The flash programmer creates a dialog box to ask you which area of the flash that you want to use to calculate the checksum. In this dialog box, select:
  - **File on Host** to calculate the checksum on the host file.
  - **File On Target** to calculate the checksum on the target using the addresses specified in the host file.
  - **Memory On Target** to calculate the checksum on the specified range of the memory on the target.
- The flash programmer gets the preference data from the **Flash Engine** panel.
- The flash programmer performs the checksum operation and reports any errors.
- The flash programmer closes the status window.

Disconnect

If you select **Flash Programmer>Disconnnect**, the flash programmer disconnects the target. This option can be useful if you want to debug your project, since protocol plug-ins can not be shared.

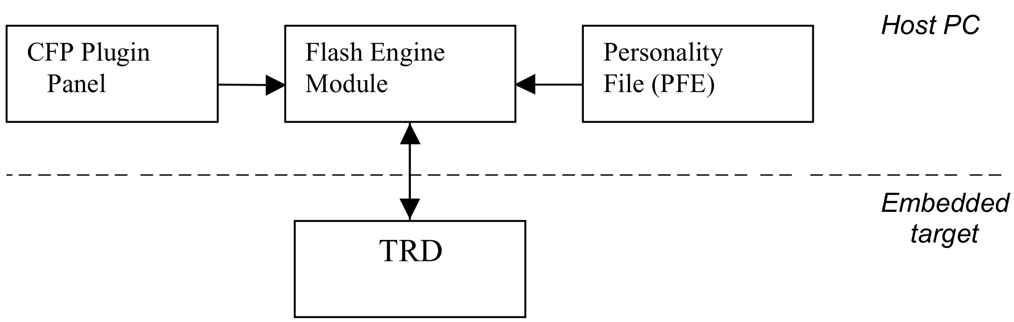
Board Support

The flash programmer supports the HC8101 and HC8102 target boards.

Modifying the Flash Programmer to Support Custom Flash Modules

This section explains how to modify the flash programmer to support custom flash modules. Figure 14.2 illustrates the flash programmer architecture.

Figure 14.2 CodeWarrior Flash Programmer Architecture



The major software components in this architecture are:

- Flash Engine Module (FEM)
- Target Resident Driver (TRD)

The minor components in this architecture are:

- CodeWarrior Flash Programmer Settings Panel
- Personality File

The Flash Engine Module drives the user interface and interacts with the CodeWarrior IDE. It downloads the Target Resident Driver (TRD) and the data to be programmed to the embedded target board. It is also responsible for communicating with the TRD and controlling it.

The TRD is the flash programming algorithm code that runs on the target board. There can be many TRDs. Every flash family requires one, as different flashes use different algorithms for the operations, such as program or erase.

TRDs can be found in the path:

`CodeWarrior\bin\plugins\Flash_Programmer\TRD directory`

Flash Engine Module (FEM)

The FEM runs on the host computer and communicates with the TRD of the embedded target through one of the protocol devices, such as the AMC WireTap, the MSI Wiggler, or the AbatronBDI.

When you execute a flash operation, the FEM performs these tasks:

- Gets your preferences from the preference panel and your personality file.

- Downloads your TRD to your target.
- Downloads the S-record to your target.
- Depending on the required operation, initializes the input buffer on the target and the stack pointer. Listing 14.1 contains the definition of the input buffer. Parameters `sParameter1` through `sParameter4` vary depending on the function (For more information, see "TRD Architecture" on page 277).

Listing 14.1 Target Input Buffer Definition

```
typedef struct
{
  INT32 sInCommandID;          /* Command identifier
*/
  UINT32 sParameter1;          /* First Parameter
*/
  UINT32 sParameter2;          /* Second Parameter
*/
  UINT32 sParameter3;          /* Third Parameter
*/
  UINT32 sParameter4;          /* Fourth Parameter
*/
} INPUT_BUFFER_t, *pINPUT_BUFFER_t;
```

- Starts the TRD, which executes a function corresponding to the Command Identifier defined in Listing 14.2.
- When TRD stops, the FEM reads the result of the performed operation from the output buffer and displays the result.

Listing 14.2 Command Identifier Definition

```
/*-- Defines - Command IDs ----------------------------
--------*/

#define CLEAR_PARAMETER                 0x0/*Initalize the
command field */
#define RESET_CMD                      0x1/*Init and reset
the Flash    */
#define PROTECTION_STATUS_CMD          0x2/*get protection
status       */
#define PROGRAM_CODE_CMD               0x3/*copy code from
RAM to Flash */
#define ERASE_SECTOR_CMD                0x4/*Erase sectors
wi a group    */
```

```
#define BLANK_CHECK_CMD                 0x5/*Blank Check
range of Flash  */
#define CHECK_SUM_CMD                 0x6/*Check Sum range
of Flash    */
#define READ_ID_CMD                     0x7/*Read the
Manufacture's ID   */
```

Target Resident Driver (TRD)

A Target Resident Driver (TRD) is the software algorithm code that runs on the target board to program the FEM. The FEM works directly with the TRD. If you have a custom board you will need to implement a TRD for it. At the very least, the CFP plug-in requires the TRD to implement the following functions: `Program()`,`Erase()` and `BlankCheck()`.

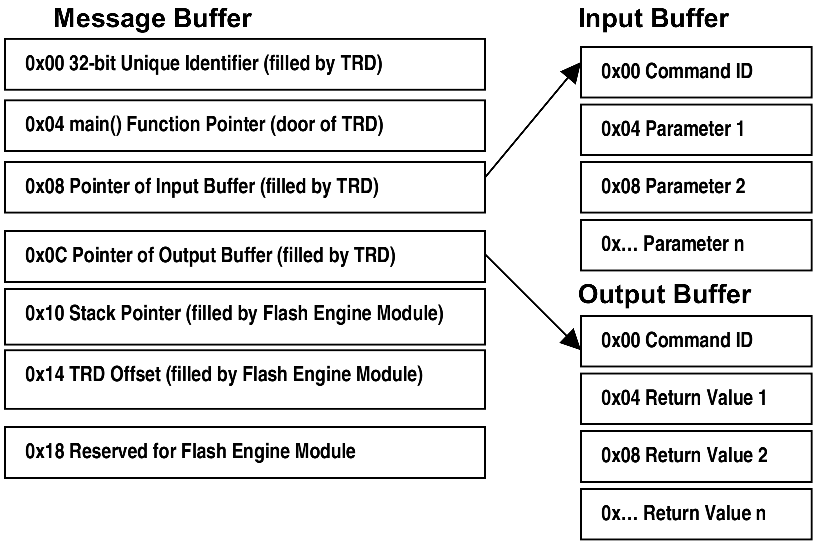
TRD Architecture

The TRD executable object is in a binary format. The TRD should be linked with Position Independent Code (PIC) and Position Independent Data(PID) enabled, and the start address of the TRD should be at `0x0`. This allows the FEM to put the TRD at any available memory location of the target board. The TRD software architecture has the following elements and ends with an invalid instruction to stop the processor from running:

- Message Buffer
- Input and Output Buffer
- TRD Code

The relationship among the message, input, and output buffers is shown in Figure 14.3.

Figure 14.3 Relationship Among the Message, Input, and Output Buffers



Message Buffer

The message buffer is a data structure that is physically located at the first address in the TRD's driver executable file. It provides the FEM the information regarding the TRD, such as the unique 32-bit identifier and pointers to the input buffer, the output buffer, and the `call-in gate` in `main()`.

The TRD has a unique 32-bit identifier for the FEM to use, to ascertain whether it is talking to the right TRD. This is necessary because many embedded target boards have more than one type of flash memory.

The TRD has a single entry point (`call-in gate`) to execute the driver code. All API functions are passed through this entry point. Each API function has a unique data structure describing the function's arguments. The FEM constructs the input parameter for each API function in the input buffer and sets the `stack pointer` before calling the `call-in gate` or `main()` pointer. This pointer is the address of the `main()` function within the TRD that calls the API function described by the contents of the input buffer. When the API function has been executed, the FEM retrieves the result of the API function call from the output buffer.

Input and Output Buffer

The message buffer contains pointers that points to the input buffer and output buffer of the TRD. These buffer structures contain the `CommandID` and a list of parameters necessary to execute an API function call, retrieved by the FEM. The FEM constructs the input parameter for an API function in the input buffer and sets the `stack pointer` before calling the `call-in gate`. Each API function defines the format of the data to be placed into the input buffer and the output buffer.

NOTE The TRD is designed to manage the input or output buffer's memory resource as an internal data structure because the TRD's code uses PIC and PID. Both read and write operations are performed on the input buffer. For this reason, the TRD must be placed within RAM address space while executing.

The TRD `call-in gate` uses the `stack pointer` value in the message buffer to set the `stack pointer` on a target board. The FEM constructs the input parameter for each API function in the input buffer and sets the `stack pointer` before calling the `call-in gate`.

NOTE The TRD is designed to manage the pointer memory resource as an internal data structure because the TRD code uses PIC and PID. The FEM writes the address of the `stack pointer` to this address. For this reason, the TRD must be placed within RAM address space while executing.

TRD Memory Layout

The memory layout for the TRD is shown in Figure 14.4.

Figure 14.4 Memory Layout for the TRD

0x0

message buffer
input buffer
output buffer
TRD code
invalid instruction

The start address of the TRD is `0x0`. This is important, as it allows you to move the TRD to any available memory location on the target. If the linker links the TRD code starting at `0x0`, then all of the pointers become an offset.

For example, if the FEM places the TRD at the memory location `0x10000` on the embedded target board, then for the FEM to get the real address of the input buffer on this target, the FEM gets the input buffer pointer from the message buffer and then adds `0x10000` to it.

The last instruction of every function has to be an invalid instruction, so it will stop the CPU and report an event back to the FEM.

TRD API Specification

This section lists the API specifications for the functions required by the CFP plug-in. These functions are:

- call-in gate( )
- Init Function
- Program( )
- Erase( )
- BlankCheck( )

call-in gate( )

The TRD `call-in-gate(main())` function is the entry point for all TRD API function calls. This function:

- Sets the stack pointer with the value in the stack pointer element in the message buffer.

- Sets a hardware/software breakpoint on an `exit` function, if necessary. If the FEM can not detect an execution of an invalid instruction, then a breakpoint is set on an `exit` function and the `call-in gate` calls the `exit` function.

NOTE You need to add a TRD Offset in the Message Buffer to the address of an exit function.

- Clears the output buffer, that is, initializes it to 0.
- Constructs a call to the API function by using the information from the input buffer, and calls the function. If the `command ID` does not match anything that the TRD supported, the function sets up the output buffer to report the error.
- Clears the input buffer, that is, initializes it to 0.
- Sets the `command ID` of the output buffer. This ensures that the API function returns successfully.
- Executes an invalid assembly instruction or calls the `exit` function to signal that the API function execution has finished. The FEM should detect an execution of an invalid instruction or a breakpoint.

Listing 14.3 shows the prototype of the `call-in-gate(main())` function.

Listing 14.3 `call-in gate((main)) Function Prototype`

```
void main(void);
//Input Param: None
//Output Param: None
//Return Param: None
```

Init Function

The TRD `Init()` function performs the following tasks:

- Performs flash-specific or target-board-specific intializations that could only be performed from the code running on the target board. In general, the CFP plug-in initializes the target by using an initialization file. This file is specified in the **Configuration File** text box in the **Flash Programmer Settings** panel.
- Sets the `return parameter` before returning to the `call-in gate`.

Listing 14.4 shows the prototype of the `Init()` function.

Listing 14.4 `Init()` Function Prototype

```
void Init(unsigned long flashBaseAddress);
//Input Parameter: unsigned long flashBaseAddress
//Output Parameter: None
//Return Parameter: Offset 0x4 of the output buffer:
//Error Code (0 indicates no error)
```

The contents of the input buffer and output buffer for the `Init( )` function are shown in Table 14.2 and Table 14.3.

Table 14.2 TRD Input Buffer Definition for `Init()`

Offset	Size (in Bytes)	Variable
0x0	4	command = COMMAND_INIT_ID
0x4	4	parameter1 = flashBaseAddress

Table 14.3 TRD Output Buffer Definition for `Init()`

Offset	Size (in Bytes)	Variable
0x0	4	command = COMMAND_INIT_ID
0x4	4	Return Value

Program( )

The TRD `Program()` function programs the memory content from RAM to flash. The FEM downloads the data to be programmed into a known memory location before calling this function. The FEM passes that memory location to the TRD in the first parameter of the input buffer. The `Program()` function programs the data starting from RAM memory location `src` to (`src+size`) into the flash starting at memory location `dest`. If this programming action fails, the function sets the output buffer with the first address of the flash where the programming action failed.

Listing 14.5 shows the prototype of the `Program()` function

Listing 14.5 `Program()` Function Prototype

```
void Program(unsigned long src,
    unsigned long dest,
    unsigned long size
```

```
    unsigned long flashBaseAddress);
//Input Parameter:
//  src - Starting address of the data in RAM space to
be programmed.
//  dest - Starting address of the flash memory to be
programmed.
//  size - Number of bytes of data to be programmed
from src to dest.
//  flashBaseAddress - The flashBase address.
//Output Parameter:
//  Offset 0x8 of output buffer - The first address
where the function //  fails to program, if any. The
Offset 0x0 should be set by the
//  call-in gate.
//Return Parameter:
//  Offset 0x4 of output buffer — Error Code (0
indicates no error).
```

The contents of the input buffer and output buffer for the `Program()` function are shown in Table 14.4 and Table 14.5.

Table 14.4 TRD Input Buffer Definition for `Program()`

Offset	Size (in Bytes)	Variable
0x0	4	command = COMMAND_PROGAM_ID
0x4	4	src
0x8	4	dest
0xC	4	size
0x10	4	flashBaseAddress

Table 14.5 TRD Output Buffer Definition for `Program()`

Offset	Size (in Bytes)	Variable
0x0	4	command = COMMAND_PROGAM_ID
0x4	4	Return Value
0x8	4	Address where it fails (if any)

Erase( )

The TRD `Erase()` function interface erases the flash memory. This function interface erases the blocks/sectors specified in the `blockMask` and `blockMaskGroupNo` parameter. It sets the output parameter for the failed erase block and returns this parameter before returning to the `call-in gate`.

Listing 14.6 shows the prototype of the `Erase()` function.

Listing 14.6 `Erase()` Function Interface Prototype

```
void Erase(unsigned long blockMask,
  unsigned long flashBaseAddress,
  unsigned long blockMaskGroupNo);
//Input Parameter:
//  blockMask - Block/Sector numbers to be erased. The
left most bit is //  the block/sector 0 and the right
most bit is block/sector 31. For   //  example, to
erase block 0-3, and 6-8, the blockMask value is
//  0xF3800000.
//  flashBaseAddress - The flashBase address.
```

```
//  blockMaskGroupNo - This variable is only used if
the flash has more //  than 32 blocks/sectors. For
blockMaskGroupNo 0, the blockMask
//  represents block number 0 to block number 31. For
blockMaskGroupNo //  1, the blockMask represents block
number 32 to block number 63.
//Output Parameter:
//  Offset 0x8 of output buffer - The block mask of the
blocks that have
//  failed the erase operation.
//  Offset 0xC of output buffer - The block mask group
number of the
//  failed block mask. Offset 0x0 should be set by
call-in gate.
//Return Parameter:
//  Offset 0x4 of output buffer - Error Code (0
indicates no error)
```

The contents of the input buffer and output buffer for `Erase`( ) are shown in Table 14.6 and Table 14.7.

Table 14.6 TRD Input Buffer Definition for `Erase()`

Offset	Size (in Bytes)	Variable
0x0	4	command = COMMAND_ERASE_ID
0x4	4	blockMask
0x8	4	flashBaseAddress
0xC	4	BlockMaskGroupNo

Table 14.7 TRD Output Buffer Definition for `Erase ()`

Offset	Size (in Bytes)	Variable
0x0	4	command = COMMAND_ERASE_ID
0x4	4	Return Value
0x8	4	blockMask
0xC	4	blockMaskGroupNo

BlankCheck( )

The `BlankCheck()` function interface performs a blank check on a specified memory range. If the specified memory range of the flash is not blank, this function interface sets the output buffer with the first address of the non-blank memory along with its data before returning to the `call-in gate`.

Listing 14.7 `BlankCheck()` Function Interface Prototype

```
void BlankCheck( unsigned long startAddress,
   unsigned long size
   unsigned long flashBaseAddress);
//Input Parameter:
//  startAddress - The start address of the flash to be
BlankChecked.
//  size - The number of bytes to check.
//  flashBaseAddress - The flashBase address.
//Output Parameter:
//  Offset 0x8 of output buffer - The first address
corresponding to
//  non-blank memory.
```

```
//  Offset 0xC of output buffer - The data at the non-
blank memory
// address. The Offset 0x0 should be set by the call-in gate.
//Return Parameter:
//  Offset 0x4 of output buffer - Error Code (0
indicates no error).
```

The contents of the input buffer and output buffer for `BlankCheck()` are shown in Table 14.8 and Table 14.9.

Table 14.8 TRD Input Buffer Definition for `BlankCheck()`

Offset	Size (in Bytes)	Variable
0x0	4	command = COMMAND_BLANKCHECK_ID
0x4	4	startAddress
0x8	4	size
0xC	4	flashBaseAddress

Table 14.9 TRD Output Buffer Definition for `BlankCheck()`

Offset	Size (in Bytes)	Variable
0x0	4	command = COMMAND_BLANKCHECK_ID
0x4	4	Return Value
0x8	4	Address of the first non-blank memory
0xC	4	Data at the first non-blank memory address

You will need to implement these functions when you are porting the flash programmer to your FEM. For an example, see `Sharp_LHF_TRD.mcp`. which is in the path:

`CodeWarrior\StarCore_Tools\Flash_Programmer_Support\TRD_Projects\Sharp_LHF`

When you have built your TRD you will have to convert it to binary format. Use the `mot2bin.exe` utility located at the following web address to do this:

`http://www.keil.com/download/docs/mot2bin.zip.asp`

You will also have to specify the same TRD name in your personality file. The TRD needs to have the extension `.trd`.

Personality File

A personality file contains information specific to each embedded target board. The personality filename extension is `.PFE`. Information is divided into these groups:

- TARGET_MEMORY
- PROCESSOR_TYPE
- FLASH

TARGET_MEMORY

Target_Memory contains these items:

- `RAM Start Address`
- `RAM Size`: This should not exceed actual size of RAM.
- `NUMBER_OF_BLOCK_GROUPS`: Number of different block groups in the flash programmer. This number has to be greater then `0`. If your flash has less then 32 blocks, it is recommended that you set this variable to `1`.

PROCESSOR_TYPE

PROCESSOR_TYPE should correspond to your target processor, either MSC8101 or MSC8102.

FLASH

FLASH contains these items:

- `FLASH_ENGINE_FILENAME`: The flash engine filename. We provide the generic file name `Flash_Engine.cfp`.
- `FLASH_PANEL_NAME`: Leave this blank if you do not have a preference panel.
- `FLASH_NAME`: The name of your flash.
- `FLASH_TYPE`: The type of your flash.

- `BLOCK_SIZE` - size of flash blocks: It is very important to have this value correct, otherwise you will not be able to perform flash operations.
- `NUMBER_OF_BLOCKS: It` is very important to have this value correct, otherwise you will not be able to perform flash operations.
- `BASE_ADDRESS`: The flash base address. It is very important to have this value correct, otherwise you will not be able to perform flash operations.
- `TRD_FILENAME`: The name of your TRD.
- `FORCE_ERASE`: Sets this to `1`, if you want the flash programmer to erase a flash value that is not in the erased state during the performance of the **Program** operation. Most flashes can not be programmed, if they are not in the erased state. If you have this variable set to `0`, the flash programmer will skip the **Erase** operation, but it may not be able to program the flash if it is not in the erased state.
- `FLASH_ID`: Some flashes allow you to read a `flash ID`. If you have implemented a TRD function to read a `flash ID`, set this value to the value specified in your flash manual. If your flash does not support this feature, set it to `0` and make your TRD return `0` in the `Return Value1` field of the output buffer.

For an example of a personality file, see `8260_ADS.pfe` in the path:

`CodeWarrior\bin\plugins\Flash_Programmer\TRD directory`

ELF/DWARF File Dump Utility

The ELF (executable and linking format) file dump utility is a standalone utility that processes absolute or linkable object files and produces an ASCII output that represents the binary information contained in those files.

Use the following command to invoke the ELF file dump utility:

`sc100-elfdmp [option]` *`file`*`...`

Table 14.10 describes the syntax elements shown on the preceding command line.

Table 14.10 ELF File Dump Utility Syntax Elements

Syntax Element	Description
`[option]`	Case-sensitive command-line options. Without options, the utility returns the contents of the ELF `Ehdr`, `Phdr`, and `Shdr` structures and the symbol table. When you specify command-line options, the utility returns only the information that you specify on the command line.
`file...`	One or more filenames, including optional pathnames. The input file must be an ELF object file, either absolute or relocatable.

For example, for an object file named `foo.eld` in the same path as the ELF file dump utility, the following command-line options are valid:

```
sc100-elfdmp -d out.txt foo.eld
sc100-elfdmp -d out.txt -c -e error.txt -h -i -v foo.eld
```

The ELF file dump utility resides in the following path for Windows hosts:

Windows *install_dir*`\CodeWarrior\StarCore Support\Compiler\bin\`

The ELF file dump utility resides in the following path for Solaris hosts:

Solaris *install_dir*`/sc140/starcore_support/bin`

Table 14.11 lists and describes the command-line options for the ELF file dump utility.

Table 14.11 ELF File Dump Utility Command-Line Options

Option	Description
`-b`	Dump disassembled section contents.
`-c`	Dump string table.
`-d`	Dump to an output file.
`-e`	Dump error messages to specified file.
`-f`	Dump file header.
`-g`	Dump DWARF debug info.
`-h`	Dump section headers.
`-i`	Dump section header string table.
`-o`	Dump program header.

Table 14.11 ELF File Dump Utility Command-Line Options (*continued*)

Option	Description
`-q`	Do not display sign on banner.
`-r`	Dump relocation information.
`-s`	Dump section contents.
`-t`	Dump symbol table.
`-v`	Dump symbolically.
`-x`	Dump in test mode.

NOTE The default option is `-fhost`.

ELF to S-Record File Conversion Utility

Use the elfsrec utility to convert ELF format files to Motorola S-record format files.

The S-record format, which is a standard Motorola file format, encodes programs or data files in a printable form for exchange among computer systems.

Installing elfsrec

When you install CodeWarrior™ for the StarCore™ DSP, the installation utility installs elfsrec in the following directory by default:

CodeWarrior_dir`\StarCore_Support\compiler\bin`

Using elfsrec

The command syntax of the elfsrec utility follows:

`elfsrec [`*`options`*`]` *`file_name`*

The *`file_name`* is the name of the input file to the utility.

Table 14.12 shows the options for the `elfsrec` utility. The options that you can use depend on the product you purchased.

Table 14.12 elfsrec Utility Options

Option	Description
`-b`	Causes elfsrec to create byte-addressable S-records. By default, elfsrec uses this option. This generates S1 records.
`-w`	Causes elfsrec to create word-addressable S-records. This generates S2 records.
`-l`	Causes elfsrec to create long-word-addressable S-records. This generates S3 records.
`-d [`*`file_name`*`]`	Causes elfsrec to write the S-records to the specified file. If you do not specify a file name, the output file has the same name as the input file with a `.s` extension.
`-o` *`value`*	Specifies a memory offset in hexadecimal or decimal format. (Hexadecimal numbers must be preceded by `0x`.) The elfsrec utility adds the specified value to the memory address of each line in the file.

Using StarCore-Specific elfsrec Options

For CodeWarrior™ for the StarCore™ DSP, you can use the following elfsrec options:

- `-l`
- `-d`
- `-o`

NOTE For StarCore, elfsrec uses the -b option by default.

SC100-stat Utility

The sc100-stat utility is a standalone statistics tool for `.eld` files.

The sc100-stat utility reads a `.eld` file and returns statistics about:

- The number of instructions
- The type of instructions
- The number of instruction sets

- The ratio between the number of instructions and instruction sets.

The syntax for sc100-stat follows:

```
sc100-stat .eld_filename [section_name...] [-d]
```

Table 14.13 describes the options for sc100-stat.

Table 14.13 sc100-stat Utility Syntax Options

Option	Description
.eld_filename	The name of the `.eld` file on which to run sc100-stat.
section_name...	An optional list of section names for sc100-stat to check. If no section names are listed, sc100-stat checks the .text section by default.
`-d`	Causes sc100-stat to print the disassembled code before the statistics.

15

Link Commander

This chapter describes Link Commander, a graphical user interface for editing linker command files.

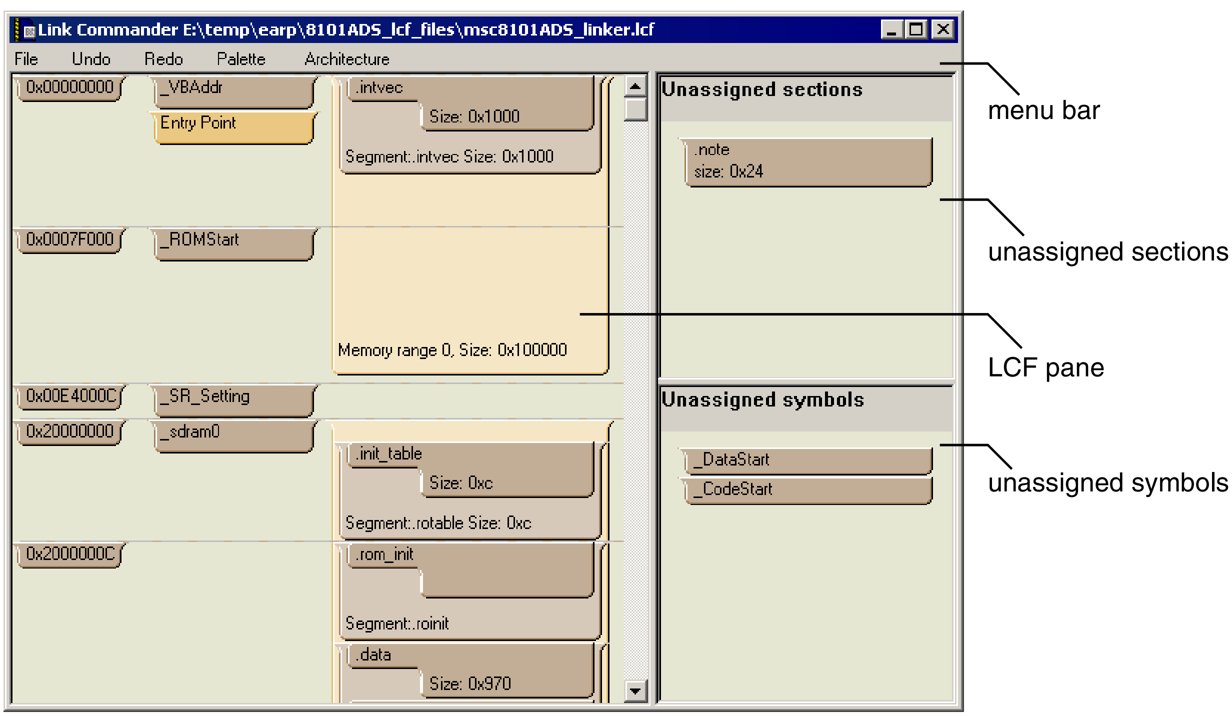
The Linker Commander window consists of a menu bar, the LCF pane, and the unassigned sections and symbols panes.

- User Interface
- Creating a Linker Command File

User Interface

This section describes the Link Commander user interface. To start, select **Project > Link Commander** from the main menu.

Figure 15.1 Link Commander Window



Menu Bar

The menu bar contains:

File Menu

The file menu contains:

- New (blank file)

  Creates a new, empty linker command file.
- New (template file)
- Creates a new linker command file using a linker command file that you select as a template.
- Open

  Opens an existing linker command file
- Save

  Saves the current linker command file.

NOTE Saving a file removes any comments that may have existed in the original linker command file. To preserve comments, use Save As to save the new linker file under a different name or path.

- Save As

  Saves the current linker command file under the name and path that you select.
- Save As and Update Project

  Saves the current linker command file under the name and path that you select, and adds the new file to the current CodeWarrior project.

Undo

The undo menu lets you undo up to five previous actions.

Redo

The redo menu lets you redo up to five previous undo actions.

Palette

The palette menu lets you change the color scheme of the Link Commander window.

Architecture

The architecture menu lets you select an architecture from the list to add memory range guides to the LCF pane based upon the selected architecture and core.

Unassigned Sections

The Unassigned Sections pane contains the sections in your project that are not yet mapped to locations within the linker command file.

To generate the list of sections within your project, you must first compile your project.

Right-click a section to access the section placement pop-up menu. Make a selection from this menu to place the section into the LCF.

Unassigned Symbols

The Unassigned Symbols pane contains common symbols in your project that have not been assigned any value.

Right-click a symbol to assign a value to it.

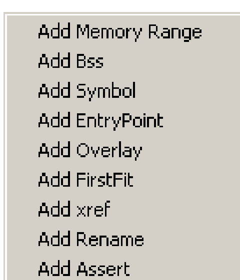
LCF Pane

The LCF pane contains a graphical representation of the linker command file.

Right-click on any existing LCF object to edit its properties.

Right-click on a blank portion of the pane to show the Add pop-up menu actions to add LCF objects.

Figure 15.2 Add menu



Creating a Linker Command File

To create an LCF using Link Commander, you:

1. Assign Memory Addresses to Symbols
2. Create Memory Ranges
3. Create Segments
4. Assign Sections
5. Create an Entry Point

Assign Memory Addresses to Symbols

1 Right-click in the LCF Pane.

2 Select Add Symbol from the pop-up menu.

Create Memory Ranges

1 Right-click in the LCF pane.

2 Select Add Memory Range from the pop-up menu.

Create Segments

1 Right-click in a memory range inside the LCF pane.

2 Select Add Segment from the pop-up menu.

Assign Sections

1 Right-click a section in the Unassigned Sections pane.

2 Select a segment to assign the section to that segment.

Create an Entry Point

1 Right-click in the LCF pane.

2 Select Add Entry Point from the pop-up menu.

16

Assembly and C Benchmarks

CodeWarrior™ for the StarCore™ DSP® includes common DSP sample benchmark source code. You can use these benchmarks for:

- Evaluating the performance of the Metrowerks Enterprise C Compiler
- Evaluating the performance of the StarCore DSP architecture
- Models of how to program for the StarCore DSP

The benchmark package contains the following items:

- C Benchmarks
- Assembly Benchmarks

C Benchmarks

The C benchmark source files reside in the following path:

Windows *CodeWarrior_dir*`\Examples\StarCore\Benchmark\c\`

Solaris *install_dir/CodeWarrior_ver_dir*`/CodeWarrior_Examples/Benchmark/c`

Table 16.1 describes the benchmarks located in that directory.

Table 16.1 C Benchmarks

Benchmark	Description

`efr/src/autocorr`
`efr/src/chebps`
`efr/src/cor_h`
`efr/src/lag_max`
`efr/src/norm_corr`
`efr/src/search_10i40`
`efr/src/syn_filt`
`efr/src/vq_subvec`
	Enhanced Full Rate GSM vocoder standard C reference code benchmarks. These functions represent the most MIPS-consuming functions in the complete vocoder application.
	
	The results of these benchmarks are a good indication of the compiler performance on real DSP applications like the EFR.

`msample/src/bqa1`	Bi-Quad Simulation (1 sample)
`msample/src/bqa2`	Bi-Quad Simulation (multi-sample, 2 samples)
`msample/src/bqa4`	Bi-Quad Simulation (multi-sample, 4 samples)
`msample/src/cora1`	Correlation Simulation (1 sample)
`msample/src/cora2`	Correlation Simulation (multi-sample, 2 samples)
`msample/src/cora4`	Correlation Simulation (multi-sample, 4 samples)
`msample/src/fira1`	FIR Simulation (1 sample)
`msample/src/fira2`	FIR Simulation (multi-sample, 2 samples)
`msample/src/fira4`	FIR Simulation (multi-sample, 4 samples)
`msample/src/iira1`	IIR Simulation (1 sample)
`msample/src/iira2`	IIR Simulation (multi-sample, 2 samples)
`msample/src/iira4`	IIR Simulation (multi-sample, 4 samples)

Running the C Benchmarks

Two sample projects exist that include all the sources needed to build the efr and msample benchmarks.

To run the C benchmarks:

1. Open the CodeWarrior project file for either the `efr` or `msample` benchmarks, which reside at the following locations:

Windows
- *CodeWarrior_dir*`\Examples\StarCore\Benchmark\c\efr\efr.mcp`

Windows
- `\`*CodeWarrior_dir*`\Examples\StarCore\Benchmark\c\msample\msample.mcp`

Solaris
- *install_dir/CodeWarrior_ver_dir*`/CodeWarrior_Examples/Benchmark/c/efr/efr.mcp`

Solaris

- *install_dir/CodeWarrior_ver_dir*/`CodeWarrior_Examples/Benchmark/c/msample/msample.mcp`

Each of these projects contains a build target for each of the source code samples.

2 To build a particular benchmark, select the target name from the Current Build Target pop-up menu in the Files tab.

3 Choose **Project > Make**.

Additional Examples

The following directories contain more example programs that you can run:

Windows
- *CodeWarrior_dir*`\Examples\StarCore\c_asm_mix`

Windows
- *CodeWarrior_dir*`\Examples\StarCore\Command_Line_Script_Debug`

Windows
- *CodeWarrior_dir*`\Examples\StarCore\EOnCEDemo`

Windows
- *CodeWarrior_dir*`\Examples\StarCore\FileIO`

Windows
- *CodeWarrior_dir*`\Examples\StarCore\Profiler`

Windows
- *CodeWarrior_dir*`\Examples\StarCore\Sc140`

Windows
- *CodeWarrior_dir*`\Examples\StarCore\Simulator`

Solaris
- *install_dir/CodeWarrior_ver_dir*/`CodeWarrior_Examples/c_asm_mix`

Solaris
- *install_dir/CodeWarrior_ver_dir*/`CodeWarrior_Examples/FileIO`

Solaris
- *install_dir/CodeWarrior_ver_dir*/`CodeWarrior_Examples/Sc140`

Solaris
- *install_dir/CodeWarrior_ver_dir*/`CodeWarrior_Examples/Command_Line_Script_Debug`

Assembly Benchmarks

The assembly benchmark source files reside in the following path:

Windows *CodeWarrior_dir*`\Examples\StarCore\Benchmark\asm`

Solaris *install_dir/CodeWarrior_ver_dir*`/CodeWarrior_Examples/Benchmark/asm`

There is an absolute and a relocatable version of each benchmark. The directories that contain each benchmark reside in one of the following directories, which are located in the overall benchmark directory mentioned in the preceding paragraph:

Windows
- `Absolute ASM`

Windows
- `Relocatable ASM`

Solaris
- `Absolute_ASM`

Solaris
- `Relocatable_ASM`

Before using the relocatable version of a benchmark, you must specify the linker command file for the benchmark in the settings panel for the Enterprise Linker or DSP Linker. (The linker command file is the file in each relocatable benchmark directory that has the extension `.mem`.)

Table 16.2 lists the assembly benchmarks.

Table 16.2 Assembly Benchmarks

Benchmark	Description
`blkmov`	Block move
`bq4`	4 multiply biquad filter
`bq5`	5 multiply biquad filter
`cfir`	Complex FIR filter
`cmax`	Complex maximum
`corr`	Correlation or convolution
`dotsq`	Dot product and square product
`eng`	Vector energy
`fft`	256 point FFT transform, radix 4
`iir`	IIR filter
`L1_norm`	Mean absolute error

Table 16.2 Assembly Benchmarks (*continued*)

Benchmark	Description
`L2_norm`	Mean square error
`lfir`	Lattice FIR filter
`liir`	Lattice IIR filter
`lmsdly`	Delayed LMS filter
`minposr`	Minimum positive ratio
`minr`	Minimum ratio
`rmin`	Real minimum
`viterbi`	Veterbi decoder
`wht`	Walsh-Hadamard transform

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